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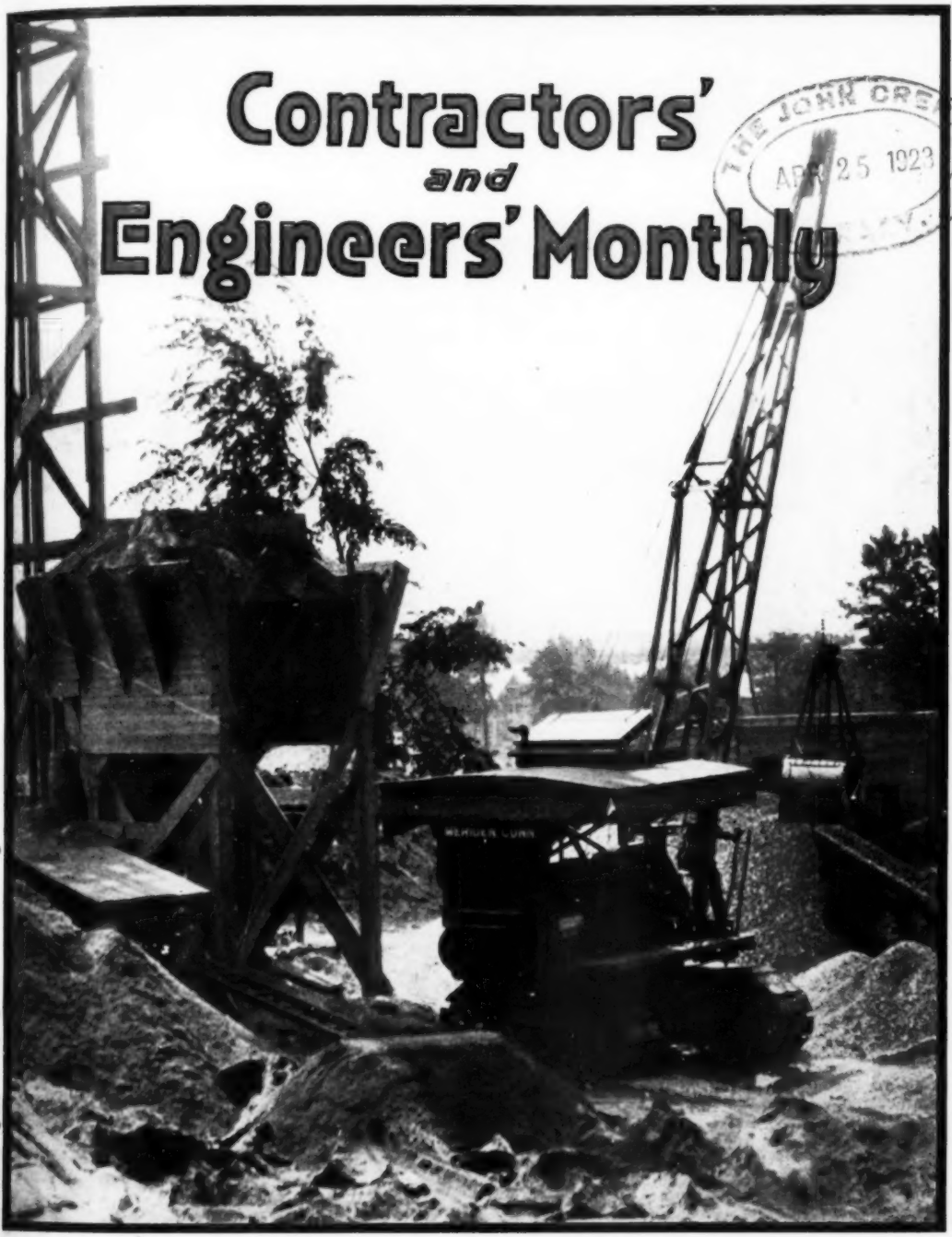

Gasoline Crane Used in Building the Weaver High School, Hartford, Conn.

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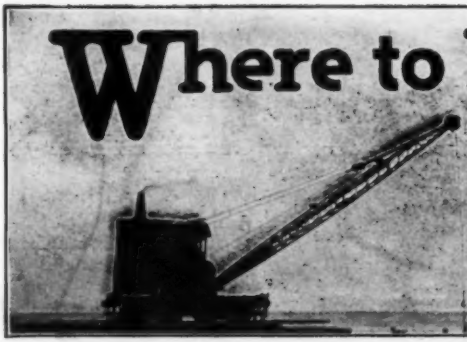

Where to Purchase

A comprehensive classification of the leading machinery and supply manufacturers arranged for the convenience of contractors, engineers and public officials who may wish to secure information about construction equipment. A star (*) before the manufacturer's name indicates that his advertisement appears in this issue.

ACETYLENE
Prest-O-Lite Co., Inc., New York.

ACETYLENE APPARATUS
Air Reduction Sales Co., New York.
Oxweld Acetylene Co., Newark, N. J.

ADDING MACHINES. (See Calculating Machines.)

AIR COMPRESSORS
*Domestic Engine & Pump Co., Shippensburg, Pa.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Chicago Pneumatic Tool Co., New York.
De Laval Steam Turbine Co., Trenton, N. J.
De La Vergne Machine Co., New York.
Fairbanks, Morse & Co., Chicago, Ill.
Gardner Governor Co., Quincy, Ill.
General Electric Co., Schenectady, N. Y.
Hardie-Tynes Mfg. Co., Birmingham, Ala.
Ingersoll-Rand Co., New York.
Nordberg Mfg. Co., Milwaukee, Wis.
Norwalk Iron Works Co., South Norwalk, Conn.
Schramm, Inc., West Chester, Pa.
Stratton & Bragg Co., Petersburg, Va.
Sullivan Mchy. Co., Chicago, Ill.
United Iron Works, Kansas City, Mo.
Westinghouse Trac. Brake Co., Wilmerding, Pa.
Worthington Pump & Mchy. Corp., New York.

ARC LAMPS
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., E. Pittsburgh, Pa.

ARTESIAN WELL DRILLS AND PUMPS
Am. Well Works, Aurora, Ill.

ASBESTOS PRODUCTS
*Carey Co., Philip, Cincinnati, Ohio.
Dominion Asbestos & Rubber Corp., New York.
Keasbey & Mattison Co., Ambler, Pa.
Mikesel Bros. Co., Chicago, Ill.
Norristown Mag. & Asb. Co., Norristown, Pa.
Sall Mountain Co., Chicago, Ill.

ASH HANDLING MACHINERY
*Haiss Mfg. Co., Geo., New York.
*International Motor Co., New York.
*Robins Conv. Belt Co., New York.
Bartlett & Snow Co., C. O., Cleveland O.
Bay City Dredge Wks., Bay City, Mich.
Brown Hoisting Mach. Co., Cleveland, Ohio.
Byers Mach. Co., Ravenna, Ohio.
Chain Belt Co., Milwaukee, Wis.
Gifford-Wood Co., Hudson, N. Y.
Green Eng. Co., East Chicago, Ind.
Guarantee Constr. Co., New York.
Jeffrey Mfg. Co., Columbus, Ohio.
Kilbourne & Jacobs Mfg. Co., Columbus, O.
Lakewood Eng. Co., Cleveland, O.
Link-Belt Co., Chicago, Ill.
Mead-Morrison Mfg. Co., E. Boston, Mass.
Portable Machinery Co., Passaic, N. J.
Webster Mfg. Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.

ASPHALT PRODUCERS
*Barber Asphalt Co., Philadelphia, Pa.
*Pioneer Asphalt Co., Lawrenceville, Ill.
*Standard Oil Co. (Indiana), Chicago, Ill.
*Texas Co., New York.
*Warren Bros. Co., Boston, Mass.
Atlantic Refining & Asphalt Corp., Phila., Pa.
Barrett Co., New York.
Gulf Refining Co., Pittsburgh, Pa.
Headley Good Roads Co., Philadelphia, Pa.
Ky. Rock Asphalt Co., Louisville, Ky.
New Orleans Refining Co., New Orleans, La.
Sinclair Ref. Co., Chicago, Ill.
Standard Oil Co. of Calif., San Francisco, Cal.
Standard Oil Co. of La., New Orleans, La.
Standard Oil Co. of N. J., Newark, N. J.
Standard Oil Co. of N. Y., New York.
U. S. Asphalt Refining Co., New York.

ASPHALT BLOCK
Hastings Pavement Co., New York.

ASPHALT CUTTERS
Dayton Pneumatic Tool Co., Dayton, Ohio.
Chicago Pneumatic Tool Co., New York
Ingersoll-Rand Co., New York.

ASPHALT KETTLES. (See Kettles for Asphalt and Tar Heating.)

ASPHALT PLANTS, TOOLS, ETC.
*Barber Asphalt Co., Philadelphia, Pa.
*Connery & Co., Philadelphia, Pa.
*Warren Bros. Co., Boston, Mass.
Austin Machinery Corp'n, Toledo, O.
Bacon Co., Edw. R., San Francisco, Cal.
Cummer & Son Co., F. D., Cleveland, O.
East Iron & Machine Co., Lima, Ohio.
Hetherington & Berner, Indianapolis, Ind.

ASPHALT ROLLERS. (See Road and Paving Rollers.)

ASPHALT SURFACE HEATERS
*Barber Asphalt Co., Philadelphia, Pa.
*Equitable Asphalt Maint. Co., Kansas City, Mo.
Hauck Mfg. Co., Brooklyn, N. Y.

BACKFILLERS
*American Cement Mchy. Co., Inc., Keokuk, Ia.
*Koehring Co., Milwaukee, Wis.
*Pawling & Harnischfeger Co., Milwaukee, Wis.
Austin Machinery Corp'n, Toledo, O.
Byers Machine Co., Ravenna, Ohio.
Constr. Mchy. Co., Waterloo, Ia.
Oshkosh Mfg. Co., Oshkosh, Wis.
Parsons Co., Newton, Ia.
Weller Mfg. Co., Chicago, Ill.

BAR BENDERS AND CUTTERS
*Koehring Co., Milwaukee, Wis.
*Ransome Concrete Mchy. Co., Dunellen, N. J.
Concrete Steel Co., New York.
Electric Welding Co., Pittsburgh, Pa.
Hinman & Co., D. A., Sandwich, Ill.
McKenna Co., Cleveland, Ohio.

BAR CHAIRS, REINFORCING
*Truscon Steel Co., Youngstown, Ohio.
Concrete Steel Co., New York.
Universal Form Clamp Co., Chicago, Ill.

BARS, IRON AND STEEL
Aborn Steel Co., Inc., New York.
Ames & Co., W., Jersey City, N. J.
Bethlehem Steel Co., Bethlehem, Pa.

Power and Speed for Heavy Duty in the Building Field

Garfords are big favorites among contractors and engineers by right of their generous power, dependability, and low cost of operation and maintenance.

A. H. Smith of Canton, Ohio, operates the 4-ton Garford shown above for hauling sand, gravel and other massive loads. At excavation pits, climbing up steep grades, or pulling out of mud, this sturdy Garford can be relied on to come through every time.

In the Garford line you are assured of equipment to match any conditions you may be called upon to meet. The valuable time of construction crews is saved by fast, sure deliveries, always on schedule, when you put Garfords on the job.

Garford Engineers—informed by careful surveys in the building field—are ready to give you the benefit of their broad experience and make valuable suggestions for bettering your haulage. Their counsel costs you nothing. Merely write us, giving the facts about your operating conditions.

The Garford Motor Truck Company, Lima, O.

Manufacturers of Motor Trucks 1 to 7½ Tons

GARFORD

DEPENDABLE TRANSPORTATION

Carbon Steel Co., Pittsburgh, Pa.
Carnegie Steel Co., Pittsburgh, Pa.
Franklin Steel Works, Franklin, Pa.
Gulf States Steel Co., Birmingham, Ala.
Hirsch Rolling Mill Co., St. Louis, Mo.
Illinois Steel Co., Chicago, Ill.
Inland Steel Co., Chicago, Ill.
Midvale Steel & Ordnance Co., Philadelphia, Pa.
Republic Iron & Steel Co., Youngstown, O.
St. Louis Screw Co., St. Louis, Mo.
Sweet's Steel Co., Williamsport, Pa.
Tenn. Coal, Iron & R. R. Co., Birmingham, Ala.
United Alloy Steel Corp., Canton, Ohio.

BELTING, RUBBER

*Goodrich Rubber Co., B. F., Akron, O.
*Robins Conv. Belt Co., New York.
Allen Mfg. Co., W. D., Chicago, Ill.
Cincinnati Rubber Mfg. Co., Cincinnati, Ohio.
Fairbanks Co., The, New York.
Goodall Rubber Co., Inc., Philadelphia, Pa.
Goodyear Tire & Rubber Co., Akron, O.
Mulconroy Co., Inc., Philadelphia, Pa.
Republic Rubber Co., Youngstown, Ohio.
Salisbury & Co., Inc., W. H., Chicago, Ill.
Southern Rubber & Belt. Co., Houston, Tex.
Union Asbestos & Rubber Co., Chicago, Ill.
U. S. Rubber Co, New York.
Voorhees Rubber Mfg. Co., Jersey City, N. J.

BINS, STORAGE

*Atlas Eng. Co., Milwaukee, Wis.
*Austin-Western Rd. Mach. Co., Chicago, Ill.
*Galion Iron Works & Mfg. Co., Galion, Ohio.
*Good Roads Mach'y Co., Kennett Square, Pa.
*Ransome Concrete Mach. Co., Dunnellen, N. J.
*Universal Road Machinery Co., Kingston, N. Y.
Austin Mfg. Co., Chicago, Ill.
Fairfield Engineering Co., Lancaster, Ohio.
Green Engineering Co., E. Chicago, Ind.
Link-Belt Co., Chicago, Ill.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Weller Mfg. Co., Chicago, Ill.

BLAST HOLE DRILLING MACHINES. (See "Well Drilling and Blast Hole Machines")

BLASTING POWDER (See Explosives)

BLOCKS AND TACKLE

Boston & Lockport Block Co., East Boston, Mass.
Broderick & Bascom Rope Co., St. Louis, Mo.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Topping Bros., New York.
Upson-Walton Co., Cleveland, Ohio.

BLOWERS, PRESSURE

American Blower Co., Detroit, Mich.
American Gas Furnace Co., New York.
De Laval Steam Turbine Co., Trenton, N. J.
General Electric Co., Schenectady, N. Y.
Spencer Turbine Co., Hartford, Conn.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.

BLOWPIPES

Oxweld Acetylene Co., Newark, N. J.

BLUE PRINT MACHINES

Dietzgen Co., Eugene, Chicago, Ill.
Keuffel & Esser Co., Hoboken, N. J.
Pease Co., C. F., Chicago, Ill.
Weber & Co., F., Philadelphia, Pa.
Wickes Bros., Saginaw, Mich.

BLUE PRINT AND TRACING PAPERS

Indianapolis Blue Print & S'ply Co., Ind'apolis.
Kolesch & Co., New York.

BOILERS

Abendroth & Root Mfg. Co., Newburgh, N. Y.
Ames Iron Works, Oswego, N. Y.
Babcock & Wilcox Co., New York.
Biggs Boiler Wks., Akron, Ohio.
Casey-Hedges Co., Chattanooga, Tenn.
Chandler & Taylor Co., Indianapolis, Ind.
Chatta. Boiler & Tank Co., Chattanooga, Tenn.
Cole Mfg. Co., R. D., Newnan, Ga.
Erie City Iron Works, Erie, Pa.
Flory Mfg. Co., S., Bangor, Pa.
Hartley Boiler Works, Montgomery, Ala.
Heine Boiler Co., St. Louis, Mo.
Houston, Stanwood & Gamble Co., Cincinnati, O.
Ladd Co., Geo. T., Pittsburgh, Pa.
Leffel & Co., J., Springfield, O.
Lord & Burnham Co., Irvington, N. Y.
Murray Iron Works Co., Burlington, Ia.
New Bern Iron Wks. & Sup. Co., New Bern, N. C.
Petroleum Iron Works Co., Sharon, Pa.
Schofield Iron Works, Macon, Ga.
Traylor Engr. & Mfg. Co., Allentown, Pa.
Valk & Murdoch Co., Charleston, S. C.
Vogt Mchy. Co., Inc., Louisville, Ky.
Walsh & Weidner Boiler Co., Chattanooga, Tenn.

BOLTS, NUTS, NAILS, RIVETS, SPIKES

Ames & Co., W., Jersey City, N. J.
American Screw Co., Providence, R. I.
American Spike Co., New York.
Ames, W. & Co., Jersey City, N. J.
Bethlehem Steel Co., Bethlehem, Pa.
Buffalo Bolt Co., Buffalo, N. Y.
Clark Bros. Bolt Co., Milldale, Conn.
Erie Bolt & Nut Co., Erie, Pa.
Foster Bolt & Nut Mfg. Co., Cleveland, Ohio.
Inland Steel Co., Chicago, Ill.
Lamson & Sessions Co., Cleveland, Ohio.
Maryland Bolt & Forge Co., Baltimore, Md.
Milton Mfg. Co., Milton, Pa.
Neely Nut & Bolt Co., Pittsburgh, Pa.
Oliver Iron & Steel Co., Pittsburgh, Pa.
Pittsburgh Screw & Bolt Co., Pittsburgh, Pa.
Progressive Mfg. Co., Torrington, Conn.
Republic Iron & Steel Co., Youngstown, O.
Rhode Island Tool Co., Providence, R. I.
Russell, Burndall & Ward Co., Port Chester, N. Y.
St. Louis Screw Co., St. Louis, Mo.
Scranton Bolt & Nut Co., Scranton, Pa.
Star Exp. Bolt Co., New York.
Sweet's Steel Co., Williamsport, Pa.

BRACES, TRENCH

Channon Mfg. Co., Jas. H., Chicago, Ill.
Duff Mfg. Co., Pittsburgh, Pa.
Kalamazoo Fdry. & Mach. Co., Kalamazoo, Mich.
Waldo Bros. & Bond Co., Boston, Mass.

BRASS GOODS

*Union Water Meter Co., Worcester, Mass.
Glauber Brass Mfg. Co., Cleveland, O.
Haydenville Co., Haydenville, Mass.
Hays Mfg. Co., Erie, Pa.
Mueller Mfg. Co., H., Decatur, Ill.
United Brass Mfg. Co., Cleveland, O.

BREAKERS, CONCRETE

*Buckeye Traction Ditcher Co., Findlay, O.
Ingersoll-Rand Co., New York City

BRICK, PAVING (See Paving Brick)

BRIDGES AND BUILDINGS, STEEL

*Frederick Snare Corporation, New York.
American Bridge Co., New York.
Bellefontaine Bridge & Steel Co., Bellefontaine, O.
Belmont Iron Works, Philadelphia, Pa.
Berlin Constr. Co., Berlin, Conn.
Bethlehem Steel Co., Bethlehem, Pa.
Blaw-Knox Co., Pittsburgh, Pa.
Boston Bridge Works, Boston, Mass.
Central States Bridge Co., Indianapolis, Ind.
Champion Bridge Co., Wilmington, O.
Chesapeake Iron Works, Baltimore, Md.
Chicago Bridge & Iron Works, Chicago, Ill.
Clinton Bridge Wks., Clinton, Iowa.
Eastern Bridge & Struc. Co., Worcester, Mass.
Ferguson Co., H. K., Cleveland, O.
Flour City Orn. Iron Co., Minneapolis, Minn.
Fort Pitt Bridge Works, Pittsburgh, Pa.
Hydraulic Steelcraft Co., Cleveland, O.
Ingalls Iron Works Co., Birmingham, Ala.
Inland Steel Co., Chicago, Ill.
Inter. Steel & Iron Co., Evansville, Ind.
King Bridge Co., Cleveland, O.
Lewis-Hall Iron Wks., Detroit, Mich.
Louisville Bridge & Iron Co., Louisville, Ky.
McClintic Marshall Co., Pittsburgh, Pa.
Milwaukee Bridge Co., Milwaukee, Wis.
Minn. Steel & Mchy. Co., Minneapolis, Minn.

Good Concrete and Speed

Users of Smith Mixers make speed because the aggregate when dumped into the drum is properly taken care of by the revolving buckets, and the "end-to-center" mixing action keeps the mix where it should be.

Also, many contractors have standardized on Smith Mixers, their working crews becoming more expert and efficient, and requiring less supervision,—both of which mean better coordination and steadier concrete production. Ample reserve is provided in the Smith power plant.

Confidence

The confidence the public has in the strength of concrete structures—foundations, bridges, dams, etc.,—is really a blind confidence.

But the confidence the construction man has is to a great extent a result of his knowledge of the permanent concrete mixed in his Smith Mixers.

Construction men are aware of the responsibilities they are shouldering,—hence the desire to be sure of the best concrete mixing on their contracts.

Smith Mixers are made for the smallest and largest jobs. In all, the design insures thorough mixing.

THE T. L. SMITH COMPANY

1015 32nd Street, Milwaukee, Wis.

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Western Warehouse: Oakland, Calif.
Agents in Principal Cities.

SMITH MIXERS

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Morava Constr. Co., Chicago, Ill.
Mt. Vernon Bridge Co., Mt. Vernon, Ohio.
Penn. Bridge Co., Beaver Falls, Pa.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Richmond Struc. Steel Co., Richmond, Va.
Riverside Bridge Co., Martins Ferry, O.
Toledo Crane Co., Toledo, O.
Virginia Bridge & Iron Co., Roanoke, Va.
Wisc. Bridge & Iron Co., North Milwaukee, Wis.

BRONZE TABLETS

Flour City Orn. Iron Co., Minneapolis, Minn.
Imperial Brass Mfg. Co., Chicago, Ill.

BROOMS, HAND FOR STREET CLEANING, ETC.

Holcomb Mfg. Co., J. I., Indianapolis, Ind.
Ind. Brush & Broom Mfg. Co., Indianapolis, Ind.
Kendallville Broom & Brush Co., Kendallville, Ind.
Lay Co., Jos., Ridgeville, Ind.
Milwaukee Brush Mfg. Co., Milwaukee, Wis.
Osborn Mfg. Co., Cleveland, Ohio.

BUCKETS, AUTOMATIC DUMPING

*Littleford Bros., Cincinnati, O
Lakewood Engineering Co., Cleveland, O.
Stuebner Iron Works, G. L., Long Island City,
Weller Mfg. Co., Chicago, Ill.

BUCKETS, CLAM SHELL

*Haiss Mfg. Co., Geo., New York.
*Owen Bucket Co., Cleveland, Ohio.
Advance Eng. Co., Cleveland, O.
Austin Machinery Corp'n, Toledo, O.
Blaw-Knox Co., Pittsburgh, Pa.
Brown Hoisting Mchy. Co., Cleveland, O.
Browning Co., Cleveland, O.
Byers Mach. Co., J. F., Ravenna, O.
Hayward Co., New York.
Industrial Works, Bay City, Mich.
Kiesler Co., J. F., Chicago, Ill.
Lakewood Engineering Co., Cleveland, O.
Link-Belt Co., Chicago, Ill.
Mead-Morrison Mfg. Co., E. Boston, Mass.
Orton & Steinbrenner Co., Chicago, Ill.
Williams Co., G. H., Erie, Pa.

BUCKETS, CONCRETE

*Koppel Ind. Car & Equip. Co., Koppel, Pa.
*Ransome Concrete Mchy. Co., Dunellen, N. J.
*Rochester Can Co., Rochester, N. Y.
*Smith Co., T. L., Milwaukee, Wis.
Insley Mfg. Co., Indianapolis, Ind.
Lakewood Engineering Co., Cleveland, O.
Union Iron Works, Inc., Hoboken, N. J.
Weller Mfg. Co., Chicago, Ill.

BUCKETS, DRAGLINE

*Sauerman Bros., Chicago, Ill.
Austin Machinery Corp'n, Toledo, O.
Brown Hoisting Mach. Co., Cleveland, O.
Bucyrus Co., So. Milwaukee, Wis.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Hayward Co., New York.
Industrial Works, Bay City, Mich.
Link-Belt Co., Chicago, Ill.
Monighan Machine Co., Chicago, Ill.

BUCKETS, DREDGING AND EXCAVATING

*Haiss Mfg. Co., Inc., Geo., New York.
*Owen Bucket Co., Cleveland, Ohio.
Austin Machinery Corp'n, Toledo, O.
Blaw-Knox Co., Pittsburgh, Pa.
Brown Hoisting Mach. Co., Cleveland, O.
Browning Co., Cleveland, O.
Hayward Co., New York.
Kiesler Co., J. F., Chicago, Ill.
Lakewood Eng. Co., Cleveland, O.
Mead-Morrison Mfg. Co., East Boston, Mass.
Williams Co., G. H., Erie, Pa.

BUCKETS, ORANGE PEEL

Hayward Co., New York.
Industrial Works, Bay City, Mich.
Kiesler Co., J. F., Chicago, Ill.
McMyler Interstate Co., Cleveland, O.
Mead-Morrison Mfg. Co., East Boston, Mass.
Orton & Steinbrenner Co., Chicago, Ill.
Vulcan Iron Works, Jersey City, N. J.

BUILDERS' HARDWARE

Corbin, P. & F., New Britain, Conn.
Reading Hardware Co., Reading, Pa.
Russell & Erwin Mfg. Co., New Britain, Conn.
Sargent & Co., New Haven, Conn.
Stanley Works, New Britain, Conn.
Yale & Towne Mfg. Co., New York.

BUILDINGS, STEEL (See Bridges and Buildings)

BUNKS AND COTS

Fort Pitt Bedding Co., Pittsburgh, Pa.
Haggard & Marcusson Co., Chicago, Ill.
Southern Rome Co., Baltimore, Md.

CABLES (See Wire and Cables)

CABLEWAYS

*Sauerman Bros., Chicago, Ill.
Broderick & Bascom Rope Co., St. Louis, Mo.
Flory Mfg. Co., S., Bangor, Pa.
Lidgerwood Manufacturing Co., New York.
Mead-Morrison Mfg. Co., E. Boston, Mass.
Roebling Sons Co., J. A., Trenton, N. J.
Street Bros. Mach. Wks., Chattanooga, Tenn.
Waterbury Co., New York.

CAISSONS

American Bridge Co., New York.
Foundation Co., New York.
Bethlehem Steel Co., Bethlehem, Pa.
O'Rourke Eng. Constr. Co., New York.
Petroleum Iron Works Co., Sharon, Pa.

CALCIUM CHLORIDE FOR ROADS

*Dow Chemical Co., Midland, Mich.
*Semet-Solvay Co., Solvay, N. Y.
Carbondale Calcium Co., Carbondale, Pa.

CALCULATING MACHINES

Burroughs Adding Machine Co., Detroit, Mich.
Felt & Tarrant Mfg. Co., Chicago, Ill.
Marchant Calc. Machine Co., Oakland, Cal.
Monroe Calculating Machine Co., Orange, N. J.

CANS FOR GARBAGE AND STREET REFUSE

*Littleford Bros., Cincinnati, O.
*Rochester Can Co., Rochester, N. Y.
American Can Co., New York.
Butler Mfg. Co., Minneapolis, Minn.
Safety Sanitary Rubbish Box Co., Columbus, O.
Steel Basket Co., Cedar Rapids, Iowa.

CARS, INDUSTRIAL V. DUMPING

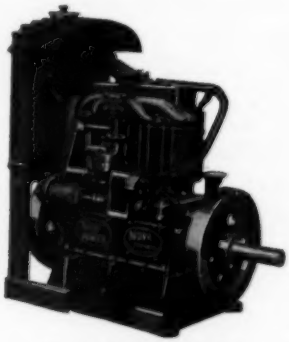
*Koppel Ind. Car & Equip. Co., Koppel, Pa.
Atlas Car & Mfg. Co., Cleveland, O.
Austin Machinery Corp'n, Toledo, O.
Chase Fdry. & Mfg. Co., Columbus, O.
Easton Car & Constr. Co., New York.
Insley Mfg. Co., Indianapolis, Ind.
Kilbourne & Jacobs Mfg. Co., Columbus, O.
Lakewood Engineering Co., Cleveland, O.
Light Ry. Equipment Co., Philadelphia, Pa.
Oliver Mfg. Co., W. J., Knoxville, Tenn.
Stuebner Iron Works, G. L., L. I. City, N. Y.
United Iron Works, Kansas City, Mo.
Weller Mfg. Co., Chicago, Ill.
Whiting Corp'n, Harvey, Ill.

CARTS, CONCRETE

*Littleford Bros., Cincinnati, O.
*Ransome Concrete Mchy. Co., Dunellen, N. J.
*Smith Co., T. L., Milwaukee, Wis.
*Sterling Wheelbarrow Co., Milwaukee, Wis.
Akron Barrow Co., Cleveland, Ohio.
Etnyre & Co., E. D., Oregon, Ill.
Gray Iron Fdry. Co., Reading, Pa.
Insley Mfg. Co., Indianapolis, Ind.
Kilbourne & Jacobs Mfg. Co., Columbus, O.
Lakewood Engineering Co., Cleveland, O.
Lee Trailer & Body Co., Chicago, Ill.
Toledo Wheelbarrow Co., Toledo, Ohio.

CAST IRON PIPE (See Pipe, Cast Iron)

Novo 2-cylinder Engine
7-9 H.P.



Novo 4-cylinder Engine
10-20 H.P.

When you need power — get a Novo

Here's why—

For many years Novo Engines have enjoyed a good reputation. They earned it. Earned it by always doing a little more and doing it a little better than was expected. They are built that way; to do their work well and keep on doing it.

Novo Engines are strictly industrial power plants. They are designed for that particular purpose. They range in size from a single-cylinder engine of 1½ horse-power to a four-cylinder engine of 40 horse-power.

To further the usefulness of Novo power, we design and build various Novo Outfits. The same workmanship, the same material and the same "know how" that has made Novo Engines what they are, go into these outfits. They are Novo built. Some are pictured on this page.

There is a Novo Engine or Outfit to meet your power requirements. Tell us how you use power and we will suggest the proper equipment to give you the service you expect of Novo.

NOVO ENGINE CO.

Clarence E. Bement, Vice-Pres. & Gen. Mgr.
LANSING — MICHIGAN

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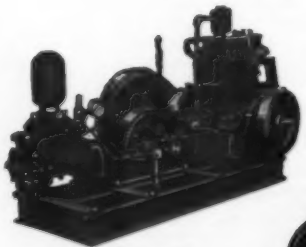
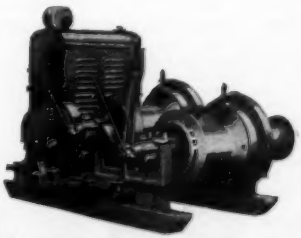


Novo AWF Pump—
Novo Built

NOVO RELIABLE POWER



Novo DH Double Drum
Hoist—Novo Built

CASTINGS, STREET AND SEWER

*Central Foundry Co., New York.
*Clark Co., H. W., Mattoon, Ill.
*Josam Mfg. Co., Michigan City, Ind.
*U. S. Cast Iron Pipe & Fdry. Co., Burlington, N. J.
Canton Foundry & Machine Co., Canton, O.
Casey-Hedges Co., Chattanooga, Tenn.
Clow & Sons, J. B., Chicago, Ill.
Dee Co., W. E., Chicago, Ill.
Portable Machinery Co., Passaic, N. J.
Foundry Mfg. Co., St. Albans, Vt.
Klauer Mfg. Co., Dubuque, Iowa.
Madison Foundry Co., Cleveland, O.
Pechstein Iron Works, Keokuk, Ia.
Sessions Foundry Co., Bristol, Conn.
South Bend Foundry Co., South Bend, Ind.

CATCH BASINS (See Castings, Street and Sewer)

CATCH BASIN CLEANING APPARATUS

*International Motor Co., New York.
Elgin Sales Corp., New York.

CAULKING MACHINERY AND TOOLS

Helwig Mfg. Co., St. Paul, Minn.
Ingersoll-Rand Co., New York.
Mueller Mfg. Co., H., Decatur, Ill.

CEILINGS, METAL

Berger Mfg. Co., Canton, O.
Canton Art Metal Co., Canton, O.
Newport Rolling Mill Co., Newport, Ky.
Klauer Mfg. Co., Dubuque, Iowa.
Mesker & Co., Geo. L., Evansville, Ind.
Milwaukee Corrugating Co., Milwaukee, Wis.
Wheeling Corrugating Co., Wheeling, W. Va.

CEMENT

*Pennsylvania Cement Co., New York
Ætna Portland Cement Co., Detroit, Mich.
Allentown Portland Cement Co., Allentown, Pa.
Alpha Portland Cement Co., Easton, Pa.
Ash Grove Lime and Portland Cement Co., Kansas City, Mo.
Atlas Portland Cement Co., New York.
Bath Portland Cement Co., Philadelphia, Pa.
Beaver Portland Cement Co., Portland, Ore.
Bessemer Limestone and Cement Co., Youngstown, O.
Bonner Portland Cement Co., Kansas City, Mo.
Canada Cement Co., Ltd., Montreal, Canada.
Cape Girardeau Portland Cement Co., Cape Girardeau, Mo.
Castalia Portland Cement Co., Pittsburgh, Pa.
Clinchfield Portland Cement Corp., Kingsport, Tenn.
Colorado Portland Cement Co., Denver, Colo.
Continental Portland Cement Co., St. Louis, Mo.
Coplay Cement Manufacturing Co., Coplay, Pa.
Cowell Portland Cement Co., San Francisco, Cal.
Crescent Portland Cement Co., Wampum, Pa.
Dewey Portland Cement Co., Kansas City, Mo.
Dexter Portland Cement Co., Nazareth, Pa.
Diamond Portland Cement Co., Cleveland, Ohio.
Dixie Portland Cement Co., Chattanooga, Tenn.
Edison Portland Cement Co., New York.
Fredonia Portland Cement Co., Fredonia, Kans.
Giant Portland Cement Co., Philadelphia, Pa.
Gilmore Portland Cement Corp., Gilmore City, Iowa.
Glens Falls Portland Cement Co., Glens Falls, N. Y.
Golden State Portland Cement Co., Los Angeles, Cal.
Gulf States Portland Cement Co., Demopolis, Ala.
Hawkeye Portland Cement Co., Des Moines, Ia.
Helderberg Cement Co., Albany, N. Y.
Hercules Cement Corp., Philadelphia, Pa.
Indiana Portland Cement Co., Indianapolis, Ind.
International Portland Cement Co., Ltd., Spokane, Wash.
Knickerbocker Portland Cement Co., Inc., New York.
Kosmos Portland Cement Co., Louisville, Ky.
Lawrence Portl'd Cement Co., Northampton, Pa.
Lehigh Portland Cement Co., Allentown, Pa.
Louisville Cement Co., Louisville, Ky.
Marquette Cement Mfg. Co., Chicago, Ill.
Missouri Portland Cement Co., St. Louis, Mo.
Monarch Cement Co., Humboldt, Kans.
Nazareth Cement Co., Nazareth, Pa.
Newaygo Portland Cement Co., Newaygo, Mich.
Nebraska Cement Co., Denver, Colo.
New Egyptian Portland Cement Co., Fenton, Mich.
New York & New England Cement & Lime Co., New York.
Northwestern States Portland Cement Co., Mason City, Ia.
Ogden Portland Cement Co., Ogden, Utah.
Oklahoma Portland Cement Co., Denver, Colo.
Old Mission Portland Cement Co., San Francisco, Cal.
Olympic Portl'd Cement Co., Ltd., Seattle, Wash.
Oregon Portland Cement Co., Portland, Ore.
Pacific Portland Cement Co., San Francisco, Cal.
Peerless Portland Cement Co., Union City, Mich.
Peninsular Portland Cement Co., Cement City, Mich.
Penn-Allen Cement Co., Allentown, Pa.
Petoskey Portland Cement Co., Petoskey, Mich.
Phœnix Portland Cement Co., Nazareth, Pa.
Portland Cement Co. of Utah, Salt Lake City, Utah.
Pyramid Portland Cement Co., Des Moines, Ia.
Riverside Portl'd Cement Co., Los Angeles, Cal.
San Antonio Portland Cement Co., San Antonio, Tex.
Sandusky Cement Co., Cleveland, Ohio.
Santa Cruz Portland Cement Co., San Francisco, Cal.
Security Cement and Lime Co., Hagerstown, Md.
Signal Mountain Portland Cement Co., Chattanooga, Tenn.
Southern States Portland Cement Co., Rockport, Ga.
Southwest'n Portland Cement Co., El Paso, Tex.
Standard Portland Cement Corp., San Francisco, Calif.
Superior Portland Cement Co., Seattle, Wash.
Texas Portland Cement Co., Dallas, Tex.
Three Forks Portland Cement Co., Denver, Colo.
Tidewater Portland Cement Co., Baltimore, Md.
Trinity Portland Cement Co., Dallas, Tex.
Union Portland Cement Co., Ogden, Utah.
United States Potash Co., Los Angeles, Cal.
U. S. Portland Cement Co., Denver, Colo.
Universal Portland Cement Co., Chicago, Ill.
Vulcanite Portland Cement Co., Philadelphia, Pa.
Wabash Portland Cement Co., Detroit, Mich.
Wellston Iron Furnace Co., Jackson, Ohio.
Western States Portland Cement Co., Independence, Kans.
Whitehall Cement Mfg. Co., Philadelphia, Pa.
Wolverine Portl'd Cement Co., Coldwater, Mich.
Wyandotte Portland Cement Co., Detroit, Mich.

CEMENT GUNS

Cement Gun Co., Allentown, Pa.

CEMENT INSPECTION (See Inspecting Laboratories)

CHAINS

American Chain Co., Inc., Bridgeport, Conn.
Chain Belt Co., Milwaukee, Wis.
Columbus McKinnon Chain Co., Columbus, O.
Diamond Chain & Mfg. Co., Indianapolis, Ind.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago, Ill.
Niagara Metal Stamp Corp., Niagara Falls, N. Y.
U. S. Chain & Forge Co., Pittsburgh, Pa.
Webster Mfg. Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.

CHECK VALVES

*Ludlow Valve Mfg. Co., Troy, N. Y.
Columbian Iron Works, Chattanooga, Tenn.
Lunkenheimer Co., Cincinnati, O.
Mueller Mfg. Co., H., Decatur, Ill.

CHEMICALS FOR WATER PURIFICATION

Du Pont de Nemours & Co., E. I., Wilmington, Del.
Electro Bleaching Gas Co., New York.
General Chemical Co., New York.
Mathieson Alkali Works, Inc., New York.
Penna. Salt Mfg. Co., Philadelphia, Pa.

*Indicates that the manufacturer carries an advertisement. See index facing inside back cover.

The ROBINS 20 ft. PORTABLE

$527.00

f.o.b. Passaic, N. J.

A *Troughed Belt* Conveyor--*No Skirt-Boards*

THIS makes it possible to handle sand, gravel, crushed stone, and other abrasive materials without damage to the edges of the belt.

Features:

16-inch Troughed Belt, large carrying capacity.

Self-cleaning arched frame, fully protecting the return belt from dirt accumulation.

Rugged construction, well balanced.

Power—2-H.P. A.C. motor, 2- or 3-phase, 60-cycle. If equipped with 5-H.P. "NEW-WAY" Engine—$81.00 additional, F. O. B. Passaic.

ROBINS CONVEYING BELT COMPANY

NEW YORK CHICAGO BOSTON PITTSBURGH

ROBINS CONVEYING BELT CO., Park Row Bldg., New York.
Send us bulletin fully describing Robins 20- and 25-ft. Portables.

Name .....

Firm .....

Address .....

CHIMNEYS, CONCRETE

Heine Chimney Co., Chicago, Ill.
Rust Engineering Co., Pittsburgh, Pa.
Weber Chimney Co., Chicago, Ill.

CHIMNEYS, RADIAL BRICK

American Chimney Corp., New York
Custodis Chimney Const. Co., Alphons, New York.
Heine Chimney Co., Chicago, Ill.
Heinicke, Inc., H. R., Indianapolis, Ind.
Kellogg & Co., M. W., New York.
Rust Engineering Co., Pittsburgh, Pa.

CHIMNEYS, STEEL (See Stacks, Steel)

CHLORINATORS

*Wallace & Tiernan Co., Inc., Newark, N. J.

CHLORINE, LIQUID (See Liquid Chlorine)

CHUTES, CONCRETE

*Ransome Concrete Mchy. Co., Dunellen, N. J.
Akron Barrow Co., Cleveland, Ohio
Insley Mfg. Co. Indianapolis, Ind.
Lakewood Engineering Co., Cleveland, O.

CLIPS, WIRE ROPE

American Hoist & Derrick Co., St. Paul, Minn.
American Steel & Wire Co., Chicago, Ill.
Broderick & Bascom Rope Co., St. Louis, Mo.
Carpenter Co., Geo. B., Chicago, Ill.
Leschen & Sons Rope Co., A., St. Louis, Mo.
Marion Malleable Iron Works, Marion, Ind.
Mockbee & Co., C. M., Cincinnati, O.
Roebling Sons Co., J. A., Trenton, N. J.
Upson-Walton Co., Cleveland, O.

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*Good Roads Mach'y Co., Kennett Square, Pa.
*Haiss Mfg. Co., Geo., New York.
*Robins Conv. Belt Co., New York.
Barber-Greene Co., Aurora, Ill.
Bartlett & Snow Co., C. O., Cleveland, Ohio.
Blaw-Knox Co., Pittsburgh, Pa.
Brown Hoisting Mchy. Co., Cleveland, O.
Byers Machine Co., Ravenna, Ohio.
Chain Belt Co., Milwaukee, Wis.
Corrugated Bar Co., Inc., Buffalo, N. Y.
Fairfield Engineering Co., Lancaster, Ohio.
Gifford-Wood Co., Hudson, N. Y.
Hayward Co., New York.
Hunt Co., Inc., C. W., West New Brighton, N. Y.
Jeffrey Mfg. Co., Columbus, O.
Kon-Wald Co., Buffalo, N. Y.
Lidgerwood Mfg. Co., New York.
Link-Belt Co., Chicago, Ill.
Mead-Morrison Mfg. Co., E. Boston, Mass.
Portable Machinery Co., Passaic, N. J.
Webster Mfg. Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.

COCKS, CURB AND CORPORATION

*Union Water Meter Co., Worcester, Mass.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Glauber Brass Mfg. Co., Cleveland, O.
Haydenville Co., Haydenville, Mass.
Mueller Mfg. Co., H., Decatur, Ill.

COLUMN CLAMPS

*Sterling Wheelbarrow Co., Milwaukee, Wis.
Blaw-Knox Co., Pittsburgh, Pa.
Hydraulic Steelcraft Co., Cleveland, O.
Insley Mfg. Co., Indianapolis, Ind.
Universal Form Clamp Co., Chicago, Ill.

COMPRESSORS, AIR (See Air Compressors)

CONCRETE FLOOR HARDENER

*Truscon Laboratories, Detroit, Mich.
Anti-Hydro Waterproofing Co., Newark, N. J.
General Chemical Co., New York.
General Fireproofing Co., Youngstown, Ohio.
Granitex Corp., New York.
Horn Co., A. C., Long Island City, N. Y.
Master Builders Co., Cleveland, O.
Sonneborn Sons, Inc., L., N. Y. "Lapidolith"

CONCRETE MIXERS

*American Cement Mchy. Co., Inc., Keokuk, Ia.
*Jaeger Machine Co., Columbus, O.
*Atlas Eng. Co., Milwaukee, Wis.
*Koehring Co., Milwaukee, Wis.
*Ransome Concrete Mchy. Co., Dunellen, N. J.
*Smith Co., T. L., Milwaukee, Wis.
Austin Machinery Corp'n, Toledo, O.
Badger Concrete Mixer Co., Milwaukee, Wis.
Chain Belt Co., Milwaukee, Wis.
Construction Mach'y Co., Waterloo, Iowa.
Contractors' Equipment Co., Keokuk, Ia.
Foote Concrete Mchy. Co., Chicago, Ill.
Gray Iron Fdry Co., Reading, Pa.
Judy Mfg. Co., Centerville, Ia.
Knickerbocker Co., Jackson, Mich.
Lakewood Engineering Co., Cleveland, O.
Lansing Co., Lansing, Mich.
Marsh-Capron Co., Chicago, Ill.
Milwaukee Concrete Mixer Co., Milwaukee, Wis.
Oshkosh Mfg. Co., Oshkosh, Wis.
Republic Iron Works, Tecumseh, Mich.
Schramm, Inc., West Chester, Pa.
Standard Scale & Supply Co., Pittsburgh, Pa.
Truckmixer Co., Milwaukee, Wis.
Worthington Pump & Mach'y Corp., New York.

CONCRETE PILING. (See Piling, Concrete)

CONCRETE REINFORCEMENT

*Truscon Steel Co., Youngstown, O.
American Steel & Wire Co., Chicago, Ill.
Bethlehem Steel Co., Bethlehem, Pa.
Carnegie Steel Co., Pittsburgh, Pa.
Concrete Steel Co., New York.
Consolidated Expanded Metal Co., Braddock, Pa.
Corrugated Bar Co., Inc., Buffalo, N. Y.
Electric Welding Co., Pittsburgh, Pa.
General Fireproofing Co., Youngstown, O.
Inland Steel Co., Chicago, Ill.
National Steel Fabric Co., Pittsburgh, Pa.
Ryerson & Son, J. T., Chicago, Ill.
Wickwire Spencer Steel Corp., New York.
Youngstown Pressed Steel Co., Warren, O.

CONCRETE ROAD FINISHERS

*Dunn Road Mach. Co., Conneaut, Ohio.
Lakewood Eng. Co., Cleveland, Ohio

CONCRETE TOOLS

*Dallett Co., Thos. H., Philadelphia, Pa.

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Dean Bros. Steam Pump Wks., Indianapolis, Ind.
Ingersoll-Rand Co., New York.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.
Wheeler Condenser & Eng. Co., Carteret, N. J.
Worthington Pump & Mach'y Corp., New York.

CONDUIT RODS

Bissell Co., F., Toledo, Ohio.
Turbine Sewer Machine Co., Milwaukee, Wis.
Waldo Bros. & Bond Co., Boston, Mass.

CONDUITS, INTERIOR

American Circular Loom Co., Boston, Mass.
Central Tube Co., Pittsburgh, Pa.
National Metal Molding Co., Pittsburgh, Pa.
Youngstown Sheet & Tube Co., Youngstown, O.

CONDUITS, UNDERGROUND

American Vitrified Products Co., Akron, Ohio.
Dickey Clay Mfg. Co., W. S., Kansas City, Mo.
Fibre Conduit Co., Orangeburg, N. Y.
Johns-Manville, Inc., New York.
National Fireproofing Co., New York.

CONTRACTORS' SUPPLY DEALERS
(See pages 103-118)

CONTRACTORS' USED EQUIPMENT

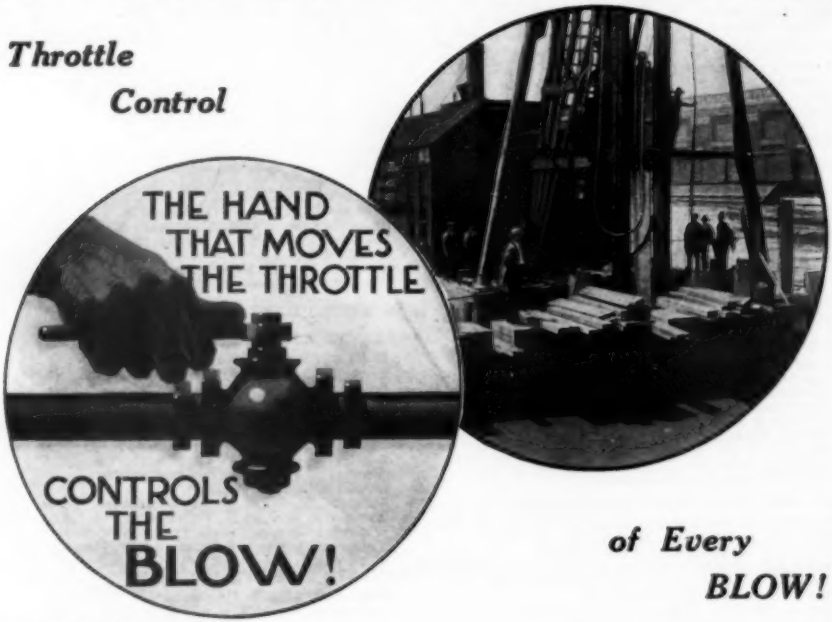
*Hastten Co., J. E., New York.
*Hollander Equipment Co., New York.

CONVEYORS, BELT

*Good Roads Mach'y Co., Kennett Square, Pa.
*Haiss Mfg. Co., Geo., New York.
*Robins Conv. Belt Co., New York.
*Russell Grader Mfg. Co., Minneapolis, Minn.
Barber-Greene Co., Aurora, Ill.
Chain Belt Co., Milwaukee, Wis.

For Concrete Pile Driving

Throttle Control



of Every BLOW!

You get it with

McKiernan-Terry Hammers

9-B and 11-B Double Acting

At last it is possible to use heavy pile hammers to drive concrete piles—or heavy timber piles—when prevailing conditions seem to indicate loading and jetting as the only method possible.

The throttle control of the blows of McKiernan-Terry 9-B and 11-B concrete Pile driving Hammers permits exact regulation of the velocity, energy and frequency of the blows!

The fact is, the throttle control made possible by these Hammers permits exact regulation of the blow for any size and type of concrete pile and soil resistance.

A touch of the operator's hand on the throttle, and the steam accelerated ram of these big hammers can be made to merely tap-tap on the pile head.

—or to deliver from 120 to 140 blows a minute using the entire force of the 1250 lb. and 3625 lb. rams.

Think this over. Your experience will tell you that throttle control of velocity, energy and frequency of ram blows is essential to meet varying conditions of driving concrete piles and heavy timber piling.

In McKiernan-Terry Double Acting pile hammers you get throttle control of every blow. Write for Bulletin 28 fully descriptive of these hammers.

McKIERNAN-TERRY DRILL COMPANY

Rock Drills **Pile Hammers** **Lifting Jacks** **Mining and Quarrying Machinery**

19 PARK ROW, NEW YORK **Works at Dover, N. J.**

Agencies in the Following Cities:

Boston, Chicago, Pittsburgh, Cleveland, Detroit, St. Paul, San Francisco, Columbus, Ohio, New Orleans, Philadelphia, Portland, Ore.

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Olson & Co., Sam'l, Chicago, Ill.
Portable Machinery Co., Passaic, N. J.
Republic Rubber Co., Youngstown, O.
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Webster Mfg. Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.

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*Atlas Engineering Co., Milwaukee, Wis.
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*Haiss Mfg. Co., Geo., New York.
*Russell Grader Mfg. Co., Minneapolis, Minn.
*Robins Conv. Belt Co., New York.
Bartlett & Snow Co., C. O., Cleveland, O.
Caldwell & Son, H. W., Chicago, Ill.
Chain Belt Co., Milwaukee, Wis.
Fairfield Engineering Co., Lancaster, Ohio.
Gifford Wood Co., Hudson, N. Y.
Godfrey Conveyor Co., Elkhart, Ind.
Guarantee Constn. Co., New York.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago, Ill.
Mead-Morrison Mfg. Co., E. Boston, Mass.
Olson & Co., Sam'l, Chicago, Ill.
Republic Rubber Co., Youngstown, O.
Stephens Adamson Mfg. Co., Aurora, Ill.
Webster Mfg. Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.

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Mathews Gravity Carrier Co., Ellwood City, Pa.

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*Koehring Co., Milwaukee, Wis.
*Pawling & Harnischfeger Co., Milwaukee, Wis.
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Brown Hoisting Mchy. Co., Cleveland, O.
Browning Co., Cleveland, O.
Bucyrus Co., South Milwaukee, Wis.
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Hanna Eng. Works, Chicago, Ill.
Industrial Works, Bay City, Mich.
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Locomotive Crane Co. of America, Champaign, Ill
Marion Steam Shovel Co., Marion, O.
McMyler Interstate Co., Cleveland, O.
Northwest Engineering Works, Chicago, Ill.
Orton & Steinbrenner Co., Chicago, Ill.
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Osgood Co., The, Marion, O.
Overland Crane Co., Hammond, Ind.
Thew Shovel Co., Lorain, O.
U. S. Crane Co., Chicago, Ill.

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*Pawling & Harnischfeger Co., Milwaukee, Wis.
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Chesapeake Iron Wks., Baltimore, Md.
Cleveland Crane & Eng. Co., Kenton, O.
Champion Engineering Co., Kenton, O.
Milwaukee Electric Crane Co., Milwaukee, Wis.
Morgan Engineering Co., Alliance, O.
Northern Eng. Works, Detroit, Mich.
Shaw Crane Works, Muskegon, Mich.
Shepard Elec. Cr. & Hst. Co., Montour Falls, N.Y.
Toledo Crane Co., Bucyrus, O.
Whiting Fdry. & Equip. Co., Harvey, Ill.

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Bucyrus Co., South Milwaukee, Wis.
Industrial Works, Bay City, Mich.

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Creosoted Materials Co., New Orleans, La.
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Republic Creosoting Co., Indianapolis, Ind.
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Southern Wood Pres. Co., Atlanta, Ga.
Wyckoff Pipe & Creosoting Co., New York.

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*Servicised Products Co., Chicago, Ill.
Am. Creosote Wks., Inc., New Orleans, La.
Barrett Co., New York.
Jennison-Wright Co., Toledo, O.
Southern Creosoting Co., Ltd., Slidell, La.
Southern Paving Const. Co., Chattanooga, Tenn.
Wyckoff Pipe & Creosoting Co., New York.

CRUSHERS AND PULVERIZERS (See Rock Crushers)

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*Austin-Western Rd. Mach. Co., Chicago, Ill.
*Galion Iron Works & Mfg. Co., Galion, Ohio.
*Good Roads Machinery Co., Kennett Square, Pa.
*Newport Culvert Co., Newport, Ky.
*Russell Grader Mfg. Co., Minneapolis, Minn.
*U. S. C. I. Pipe & Fdry. Co., Burlington, N. J.
American Cast Iron Pipe Co., Birmington, Ala.
Canton Culvert & Silo Co., Canton, O.
Concrete Form Co., Inc., Syracuse, N. Y.
Dee Co., W. E., Chicago, Ill.
Dominion Metal Products Corp., Roanoke, Va.
Florida Metal Products Co., Jacksonville, Fla.
Hardesty Mfg. Co., The R., Denver, Colo.
Klauer Mfg. Co., Dubuque, Ia.
Lyle Culv. & Rd. Equip. Co., Minneapolis, Minn.
Madison Foundry Co., Cleveland, O.
Southern Metal Culvert Co., Salisbury, N. C.
Wheeling Corrugating Co., Wheeling, W. Va.
Wood & Co., R. D., Philadelphia, Pa.

CURB BOXES

*Clark Co., H. W., Mattoon, Ill.
Casey-Hedges Co., Chattanooga, Tenn.
Clow & Sons, J. B., Chicago, Ill.
Foundry Mfg. Co., St. Albans, Vt.
Madison Foundry Co., Cleveland, O.
Mueller Mfg. Co., Decatur, Ill.
Thompson-Fleming Co., Inc., Buffalo, N. Y.

CURB GUARDS, STEEL

Godwin Co., W. S., Baltimore, Md.

CURB, STEEL PROTECTED

*Truscon Steel Co., Youngstown, O.
Concrete Steel Co., New York.
National Steel Fabric Co., Pittsburgh, Pa.
Steel Protected Concrete Co., Philadelphia, Pa.

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Armstrong Mfg. Co., Bridgeport, Conn.
Barnes Tool Co., New Haven, Conn.
Erie Tool Works, Erie, Pa.
Greenfield Tap & Die Corp'n., Greenfield, Mass.
Oswego Tool Co., Oswego, N. Y.
Reed Mfg. Co., Erie, Pa.
Walworth Mfg. Co., Boston, Mass.

CUTTERS, ROD AND WIRE

*Koehring Co., Milwaukee, Wis.
Buffalo Forge Co., Buffalo, N. Y.
Carolus Mfg. Co., Sterling, Ill.
Carpenter & Co., Geo. B., Chicago, Ill.
Helwig Mfg. Co., St. Paul, Minn.
Worthington Pump & Mchy. Corp., New York.

CUTTING AND WELDING APPARATUS

Macleod Co., Cincinnati, O.
Milburn Co., Alexander, Baltimore, Md.
Prest-O-Lite Co., Inc., New York.

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American Hoist & Derrick Co., St. Paul, Minn.
Byers Machine Co., Ravenna, O.
Carpenter & Co., Geo. B., Chicago, Ill.
Clyde Iron Works Sales Co., Duluth, Minn.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Federal Bridge & Struc. Co., Waukesha, Wis.
Flory Mfg. Co., S., Bangor, Pa.
Horton Co., John T., New York.
Insley Mfg. Co., Indianapolis, Ind.
Lakeside Bridge & Steel Co., N. Milwaukee, Wis.
Lidgerwood Manufacturing Co., New York.
Lincoln Iron Works, Rutland, Vt.
National Hoisting Engine Co., Harrison, N. J.
Sauger Derrick Co., Chicago, Ill.
Smith, Whitcomb & Cook Co., Barre, Vt.
Superior Iron Works, Superior, Wis.

Considers His P & H Excavators Best All-Around Machinery He Ever Owned

WESTERN UNION TELEGRAM

WILMINGTON, N. C. AUG. 17, 1922.

D. M. PHILLIPS
C/O TEXAS COMPANY
HOUSTON, TEXAS.

I HAVE THREE, TWO NAUGHT SIX, P & H MACHINES, TWO AS DRAGLINES AND ONE AS SHOVEL. THE SHOVEL NOW LOADING LIMESTONE ROCK FOR CRUSHER PLANT AND GIVING EXCELLENT RESULTS. I EXPECT NOW TO REPLACE ALL MY STEAM MACHINES WITH THIS TYPE SHOVEL AS I CONSIDER THEM THE BEST ALL ROUND PIECE OF MACHINERY I EVER OWNED.

C. W. LACY

C. W. LACY
Contractor
P. O. Box 666
Wilmington, N.C. June 23rd. 1922.

H. H. Hoppendietzel Construction Co.
General Contractors,
Macon, Ga.
Gentlemen:-

Replying to your letter, 21st. inst. asking if I had a P. & H. 206 Machine for sale, will say that I have not.

I am now operating,(3), 206 machines, 2 as drag lines and one as shovel and do not care to sell either, on the other hand, I have a [redacted] Steam Machine I would like to sell and replace with a 206 P. & H.

Yours truly,

C. W. Lacy

Now Buys Another

As a further indication of this contractor's strong belief in P & H Equipment, a fourth P & H 210 Dragline was purchased by him.

BULLETIN 57-X gives complete P & H Excavator information—a copy will be sent on request.

PAWLING & HARNISCHFEGER COMPANY
Established in 1884
3819 National Ave., Milwaukee, Wis.
Offices and Agents in Principal Cities

PAWLING & HARNISCHFEGER CO. P AND H TRADE MARK OF P+H EQUIPMENT

GASOLINE SHOVEL

DERRICKS, PIPE LAYING

Austin Machinery Corp'n, Toledo, O.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Lidgerwood Manufacturing Co., New York.
Mueller Mfg. Co., H., Decatur, Ill.

DERRICKS, REVOLVING

Clyde Iron Works Sales Co., Duluth, Minn.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Lidgerwood Manufacturing Co., New York.

DERRICKS, STEEL

*Pawling & Harnischfeger Co., Milwaukee, Wis.
American Hoist & Derrick Co., St. Paul, Minn.
Austin Machinery Corp'n, Chicago, Ill.
Buffalo Hoist & Derrick Co., Buffalo, N. Y.
Clyde Iron Works Sales Co., Duluth, Minn.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Federal Bridge & Struc. Co., Waukesha, Wis.
Hayward Co., New York.
Insley Mfg. Co., Indianapolis, Ind.
Lakeside Bridge & Steel Co., N. Milwaukee, Wis.
Lidgerwood Manufacturing Co., New York.
Taylor Portable Steel Derrick Co., Chicago, Ill.

DERRICKS, STEEL PORTABLE

Austin Machinery Corp'n, Toledo, O.
Blaw-Knox Co., Pittsburgh, Pa.
Clyde Iron Works Sales Co., Duluth, Minn.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Lidgerwood Manufacturing Co., New York.
Taylor Portable Steel Derrick Co., Chicago, Ill.

DERRICKS, TRAVELING

American Hoist & Derrick Co., St. Paul, Minn.
Austin Machinery Corp'n, Toledo, O.
Bay City Dredge Works, Bay City, Mich.
Byers Machine Co., Ravenna, Ohio.
Clyde Iron Works Sales Co., Duluth, Minn.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Hayward Co., New York.
Nat'l Hoisting Engine Co., Harrison, N. J.
Orton & Steinbrenner Co., Chicago, Ill.

DISTRIBUTING PLANTS, CONCRETE

*Koehring Co., Milwaukee, Wis.
*Ransome Concrete Mchy. Co., Dunellen, N. J.
Archer Iron Works, Chicago, Ill.
Insley Mfg. Co., Indianapolis, Ind.
Lakewood Engineering Co., Cleveland, O.

DITCHING MACHINES (See Excavators, Ditch and Trench)

DIVIDING PLATES (ROAD)

*Godwin Co., W. S., Baltimore, Md.

DOORS, METAL

Central Metal Products Corp., Canton, Ohio.
Dahlstrom Metallic Door Co., Jamestown, N. Y.
Friedrich Co., E. H., Holyoke, Mass.
Lawton-Stephens Co., Brooklyn, N. Y.
McFarland Co., J. C., La Porte, Ind.
Penn Metal Co., Boston, Mass.
Riester & Thesmacher Co., Cleveland, Ohio.
Sykes Co., Chicago, Ill.
Thorp Fire Proof Door Co., Minneapolis, Minn.

DOORS AND SHUTTERS, STEEL ROLLING

Cornell Iron Works, New York.
Kinnear Mfg. Co., Columbus, O.
Variety Mfg. Co., Chicago, Ill.
Wilson Corp., J. G., New York.

DRAFTING MACHINES

Universal Drafting Machine Co., Cleveland, O.

DREDGES

American Steel Dredge Co., Fort Wayne, Ind.
Bay City Dredge Works, Bay City, Mich.
Bucyrus Co., South Milwaukee, Wis.
Ellicott Machine Corp'n., Baltimore, Md.
Erie Steam Shovel Co., Erie, Pa.
Hayward Co., New York.
Lidgerwood Mfg. Co., New York.
Marion Steam Shovel Co., Marion, O.
Osgood Co., The, Marion, O.
Stockton Iron Works, Stockton, Cal.
Street Bros. Mach. Wks., Chattanooga, Tenn.
Superior Iron Works, Superior, Wis.
Vulcan Iron Works, Jersey City, N. J.

DREDGES, DIPPER

*Fairbanks Steam Shovel Co., Marion, O.
American Steel Dredge Co., Fort Wayne, Ind.
Austin Machinery Corp'n, Toledo, O.
Bay City Dredge Works, Bay City, Mich.
Bucyrus Co., South Milwaukee, Wis.
Marion Steam Shovel Co., Marion, O.
Osgood Co., Marion, O.

DREDGES, HYDRAULIC

*Fairbanks Steam Shovel Co., Marion, O.
Bucyrus Co., South Milwaukee, Wis.
Ellicott Mach. Corp., Baltimore, Md.
Marion Steam Shovel Co., Marion, O.
Morris Machine Works, Baldwinsville, N. Y.

DREDGING PUMPS AND ACCESSORIES

Erie Pump & Engine Wks., Medina, N. Y.

DRILLS, AIR

*Dallett Co., Thos. H., Philadelphia, Pa.
*Denver Rock Drill Mfg. Co., Denver, Colo.
*McKiernan-Terry Drill Co., New York.
Chicago Pneumatic Tool Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Cleveland Rock Drill Co., Cleveland, Ohio.
Helwig Mfg. Co., St. Paul, Minn.
Independent Pneumatic Tool Co., Chicago, Ill.
Ingersoll-Rand Co., New York.
Sullivan Machinery Co., Chicago, Ill.

DRILLS, CORE

*McKiernan-Terry Drill Co., New York.
Dobbins Core Drill Co., Inc., New York.
Ingersoll-Rand Co., New York.
Standard Diamond Drill Co., Chicago, Ill.
Sullivan Mach'y Co., Chicago, Ill.

DRILLS, HAMMERS (PNEUMATIC)

*Denver Rock Drill Mfg. Co., Denver, Colo.
*McKiernan-Terry Drill Co., New York.
Chicago Pneumatic Tool Co., New York.
Cleveland Pneumatic Tool Co., Cleveland, O.
Cleveland Rock Drill Co., Cleveland, O.
Ingersoll-Rand Co., New York.
Sullivan Machinery Co., Chicago, Ill.

DRILLS, ROCK

*Dallett Co., Thos. H., Philadelphia, Pa.
*Denver Rock Drill Mfg. Co., Denver, Colo.
*McKiernan-Terry Drill Co., New York.
Chicago Pneumatic Tool Co., New York.
Cleveland Rock Drill Co., Cleveland, Ohio.
Helwig Mfg. Co., St. Paul, Minn.
Ingersoll-Rand Co., New York.
Sullivan Machinery Co., Chicago, Ill.
Wood Drill Works, Paterson, N. J.

DRILLS FOR WELLS AND BLAST HOLES (See Well Drilling Machinery)

DRUMS, HOLDING

Blaw-Knox Co., Pittsburgh, Pa.
Clyde Iron Works Sales Co., Duluth, Minn.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Hayward Co., New York.
Monighan Machine Co., Chicago, Ill.

DRYERS, ASPHALT AND CEMENT

Allis-Chalmers Co., Milwaukee, Wis.
American Blower Co., Detroit, Mich.
American Process Co., New York.
Atlas Dryer Co., Cleveland, O.
Bartlett & Snow Co., C. O., Cleveland, O.
Cummer & Son Co., F. D., Cleveland, O.
East Iron & Machine Co., Lima, O.
Ruggles-Coles Eng. Co., New York.
Variety Iron & Steel Works, Cleveland, O

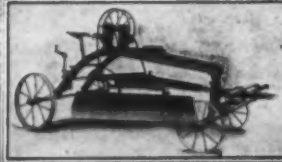
DRYERS, SAND AND GRAVEL

*Littleford Bros., Cincinnati, Ohio.

DUMP BODIES FOR MOTOR TRUCKS

*Heil Company, Milwaukee, Wis.

ROAD MACHINERY
that pays for itself



WINNER HIGHWAY PATROL ROAD GRADER. Winner Graders are made in six different sizes.

NO. 4 CHAMPION STEEL ROCK CRUSHER, Mounted, with Elevator, Screen and Portable Stone Bin.

A piece of road building equipment that pays for itself in the returns it brings to the user is an investment.

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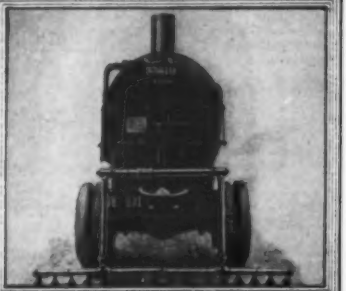
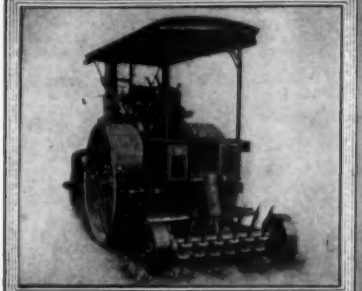
We furnish a complete line of Road Building Machinery. Six different sizes of Road Graders, Portable and Stationary Rock Crushers, Elevators, Screens, Conveyors, Bins, Oiling Machinery, Heating Kettles, Road Drags and Culvert Pipe.

If you are looking for high grade machinery and genuine service we would like to hear from you.



CHAMPION HEATING DISTRIBUTOR For applying all grades of bituminous binders.



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"EVERYTHING *for the* ROADMAKER"
WILL INTEREST YOU. IT IS FREE ON REQUEST

*International Motor Co., New York.
*Littleford Bros., Cincinnati, O.
American Truck Body Co., Inc., Martinsville, Va.
Archer Iron Works, Chicago, Ill.
Auto Truck Steel Body Co., Chicago, Ill.
Columbian Steel Tank Co., Kansas City, Mo.
Horizontal Hydraulic Hoist Co., Detroit, Mich.
Jennings Automatic Dump Body, Roanoke, Va.
Lee Trailer & Body Co., Chicago, Ill.
Pechstein Iron Works, Keokuk, Iowa.
Simplex Mfg. Co., Conneautville, Pa.
Van Dorn Iron Wks., Cleveland, Ohio.
Wood Hydraulic Hoist & Body Co., Detroit, Mich.

DUMP CARTS AND WAGONS, HORSE DRAWN

*Austin Western Road Mchy. Co., Chicago, Ill.
*Russell Grader Mfg. Co., Minneapolis, Minn.
Acme Road Machinery Co., Frankfort, N. Y.
Acme Wagon Co., Emigsville, Pa.
Austin Mfg. Co., Chicago, Ill.
Eagle Wagon Works, Auburn, N. Y.
Holzbog & Bro., Geo. H., Jeffersonville, Ind.
Stroud & Co., Omaha, Nebr.
Tiffin Wagon Co., Tiffin, Ohio.
Watson Products Corp., Canastota, N. Y.
Western Wheeled Scraper Co., Aurora, Ill.

DUST LAYING AND ROAD BINDER MATERIALS

*Dow Chemical Co., Midland, Mich.
*Semet-Solvay Co., Solvay, N. Y.
*Standard Oil Co. (Indiana), Chicago, Ill.
*Texas Co., New York.
Barrett Co., New York.
Carbondale Calcium Co., Carbondale, Pa.
Dustoline for Roads Co., Summit, N. J.

DYNAMITE (See Explosives)

EJECTORS, SEWAGE

Pacific Flush Tank Co., Chicago, Ill.
Yeomans Bros. Co., Chicago, Ill.

ELECTRIC GENERATORS AND MOTORS

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Crocker-Wheeler Co., Ampere, N. J.
Fairbanks, Morse & Co., Chicago, Ill.
General Electric Co., Schenectady, N. Y.
Ideal Elec. & Mfg. Co., Mansfield, O.
Lincoln Electric Co., Cleveland, O.
Robbins & Myers Co., Springfield, O.
Triumph Electric Co., Cincinnati, O.
Wagner Elec. Mfg. Co., St. Louis, Mo.
Western Electric Co., New York.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

ELECTRIC LAMPS

General Electric Co., Schenectady, N. Y.
Westinghouse Lamp Co., New York.

ELECTRIC LIGHTING PLANTS

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Climax Engineering Co., Clinton, Ia.
Fairbanks, Morse & Co., Chicago, Ill.
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.
Western Electric Co., New York.

ELECTRIC SUPPLIES, METERS, ETC.

Bissell Co., F., Toledo, Ohio.
General Electric Co., Schenectady, N. Y.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

ELECTRIC TRANSFORMERS

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.
Kuhlman Electric Co., Bay City, Mich.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

ELECTRIC WIRES AND CABLES. (See "Wire and Cable")

ELEVATORS, BUCKET

Atlas Eng. Co., Milwaukee, Wis.
*Austin Western Road Machy. Co., Chicago, Ill.
*Good Roads Mach'y Co., Kennett Square, Pa.
*Haiss Mfg. Co., Geo., New York.
*Littleford Bros., Cincinnati, Ohio.
*Robins Conv. Belt Co., New York.
*Russell Grader Mfg. Co., Minneapolis, Minn.
*Universal Road Machinery Co., Kingston, N. Y.
Austin Mfg. Co., Chicago, Ill.
Bartlett & Snow Co., C. O., Cleveland, Ohio.
Chain Belt Co., Milwaukee, Wis.
Fairfield Engineering Co., Lancaster, Ohio.
Gifford-Wood Co., Hudson, N. Y.
Jeffrey Mfg. Co., Columbus, O.
Link-Belt Co., Chicago, Ill.
Olson & Co., Sam'l, Chicago, Ill.
Webster Mfg. Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.
Worthington Pump & Mchy. Corp., New York.

ELEVATORS, PASSENGER, FREIGHT, ETC.

Albro-Clem Elevator Co., Philadelphia, Pa.
Amer. Elevator & Mach. Co., Louisville, Ky.
Bay State Elevator Co., Springfield, Mass.
Haughton Elev. & Mach. Co., Toledo, Ohio.
Kaestner & Hecht Co., Chicago, Ill.
Llewellyn Iron Works, Los Angeles, Cal.
Montgomery Elevator Co., Moline, Ill.
Otis Elevator Co., New York.
Ridgeway & Son Co., C., Coatesville, Pa.
See Elec. Elevator Co., A. B., New York.
Speidel, J. G., Reading, Pa.
Warner Elevator Mfg. Co., Cincinnati, O.
Warsaw Elevator Co., Warsaw, N. Y.

ENGINES, GAS AND GASOLINE

*Domestic Engine & Pump Co., Shippensburg, Pa.
*Hercules Corpn., Evansville, Ind.
*Holt Mfg. Co., Peoria, Ill.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
C. H. & E. Mfg. Co., Milwaukee, Wis.
Charter Gas Eng. Co., Sterling, Ill.
Chicago Pneumatic Tool Co., New York.
Climax Engineering Co., Clinton, Ia.
Evinrude Motor Co., Milwaukee, Wis.
Fairbanks, Morse & Co., Chicago, Ill.
Foos Gas Engine Co., Springfield, Ohio.
Fuller & Johnson Mfg. Co., Madison, Wis.
Gade Bros. Mfg. Co., Iowa Falls, Iowa.
Nelson Bros. Co., Saginaw, Mich.
"New-Way" Motor Co., Lansing, Mich.
Novo Engine Co., Lansing, Mich.
Universal Motor Co., Oshkosh, Wis.
Weber Engine Co., Kansas City, Mo.
Wellman-Seaver-Morgan Co., Cleveland, O.
Worthington Pump & Mchy. Corp., New York.

ENGINES, HIGH DUTY WATER-WORKS

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
De Laval Steam Turbine Co., Trenton, N. J.
Fairbanks, Morse & Co., Chicago, Ill.
Morris Machine Works, Baldwinsville, N. Y.
Murray Iron Works Co., Burlington, Ia.
Worthington Pump & Mchy. Corp., New York.

ENGINES, OIL

DIESEL

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Busch-Sulzer Bros.-Diesel Eng. Co., St. Louis, Mo.
Dodge Sales & Eng. Co., Mishawaka, Ind.
Fulton Iron Works Co., St. Louis, Mo.
Hadfield-Penfield Steel Co., Bucyrus, Ohio.
McIntosh & Seymour Corp., Auburn, N. Y.
Nordberg Mfg. Co., Milwaukee, Wis.
Western Machy. Co., Los Angeles, Cal.

SEMI-DIESEL

Advance Rumely Thresher Co., La Porte, Ind.
Anderson Fdry. & Mach. Co., Anderson, Ind.
Bessemer Gas Eng. Co., Grove City, Pa.
Buckeye Machinery Co., Lima, O.
Charter Gas Eng. Co., Sterling, Ill.
Chicago Pneumatic Tool Co., New York.
De La Vergne Machine Co., New York.
Evinrude Motor Co., Milwaukee, Wis.
Fairbanks, Morse & Co., Chicago, Ill.
Foos Gas Engine Co., Springfield, O.
Ingersoll-Rand Co., New York.
Midwest Engine Co., Indianapolis, Ind.
Muncie Oil Eng. Co., Muncie, Ind.
Nordberg Mfg. Co., Milwaukee, Wis.
St. Mary's Oil Eng. Co., St. Charles, Mo.
Stover Mfg. & Engine Co., Freeport, Ill.
Taylor Machine Co., Cleveland, O.
Weber Engine Co., Kansas City, Mo.
Worthington Pump & Mchy. Corp., New York.

ENGINES, PUMPING

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
American Gas Engine Co., Kansas City, Mo.
American Well Works, Aurora, Ill.
Climax Engineering Co., Clinton, Ia.

Stockland Quicklift Graders are bought on Performance

Successful contractors, highway engineers and officials are inclined to look beneath the paint—behind the design—back of the reputation—at the actual *materials, construction,* and *performance* of the machine in service.

Buying on performance is the safe method—it eliminates many a disappointment. It re-assures satisfaction It avoids the guess-work and disillusionments that frequently follow "high pressure sale."

Stockland Graders are being bought in constantly increasing numbers—***on performance.***

Any of the 51 Stockland distributors will gladly tell you where and when you can see a Stockland Quicklift Grader in operation, on actual road work, handled by its regular operator Then ***you*** can buy on ***performance.***

Write for Stockland 1923 literature today

THE STOCKLAND MOVES MORE EARTH WITH LESS POWER

Not just a claim — but a demonstrable fact, backed by actual grading records.

The Stockland blade is a ***cutting edge*** which cuts ***under*** the earth. Certainly this makes less demand upon power than ***scraping.***

The earth is then ***rolled*** to one side—***not pushed***—by the ***scientifically curved*** Stockland Moldboard.

Instead of ***carrying*** the earth in front of the moldboard the ***power*** is devoted to ***cutting and rolling***—actual earth moving.

Because the Stockland blade ***cuts*** it is drawn ***down and into*** the cut—it cannot drop into soft places or scrape and chatter over the hard spots. This gives a clean, uniform, once-over cut. You can verify the reasonableness of this important advantage by asking your dealer about Stockland Quicklift Graders.

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Deming Co., Salem, O.
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Enterprise Mchy. Co., Minneapolis, Minn.
Midwest Engine Co., Indianapolis, Ind.
Nordberg Mfg. Co., Milwaukee, Wis.
United Iron Works, Inc., Kansas City, Mo.
Weinman Pump Mfg. Co., Columbus, O.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.
Worthington Pump & Mchy. Corp., New York.

ENGINES, STEAM

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Dake Engine Co., Grand Haven, Mich.
Erie-Ball Engine Co., Pittsburgh, Pa.
Erie Pump & Engine Co., Medina, N. Y.
Filer-Stowell Co., Milwaukee, Wis.
Hardie-Tynes Mfg. Co., Birmingham, Ala.
Leffel Co., J., Springfield, O.
Morris Machine Works, Baldwinsville, N. Y.
Murray Iron Works Co., Burlington, Ia.
Nordberg Mfg. Co., Milwaukee, Wis.
Sturtevant Co., B. F., Hyde Park, Boston, Mass.
Vilter Mfg. Co., Milwaukee, Wis.

ENGINES, TRACTION

*Austin-Western Road Mchy. Co., Chicago, Ill.
*Holt Mfg. Co., Peoria, Ill.
International Harvester Co., Chicago, Ill.
Oliver Tractor Co., Knoxville, Tenn.
Phoenix Mfg. Co., Eau Claire, Wis.

EXCAVATING MACHINERY. (See Names Under Excavators, also Steam Shovels)

EXCAVATORS, CABLEWAY

*Smith Co., T. L., Milwaukee, Wis.
Bucyrus Co., South Milwaukee, Wis.
Byers Machine Co., Ravenna, Ohio.
Lidgerwood Mfg. Co., New York.

EXCAVATORS, DITCH AND TRENCH

*Buckeye Traction Ditcher Co., Findlay, O.
*Fairbanks Steam Shovel Co., Marion, O.
*Keystone Driller Co., Beaver Falls, Pa.
*Pawling & Harnischfeger Co., Milwaukee, Wis.
*Russell Grader Mfg. Co., Minneapolis, Minn.
American Hoist & Derrick Co., St. Paul, Minn.
Austin Machinery Corp'n, Toledo, O.
Bay City Dredge Works, Bay City, Mich.
Byers Machine Co., Ravenna, Ohio.
Ball Engine Co., Erie, Pa.
Bucyrus Co., South Milwaukee, Wis.
Clyde Iron Works Sales Co., Duluth, Minn.
Economy Excavator Co., Iowa Falls, Ia.
Erie Steam Shovel Co., Erie, Pa.
Hayward Co., The, New York City.
Marion Steam Shovel Co., Marion, O.
Monighan Machine Co., Chicago, Ill.
Osgood Co., Marion, O.
Parsons Co., Newton, Ia.

EXCAVATORS, DRAG-LINE

*Bay City Dredge Works, Bay City, Mich.
*Pawling & Harnischfeger Co., Milwaukee, Wis.
*Sauerman Bros., Chicago, Ill.
*Smith Co., T. L., Milwaukee, Wis.
Austin Machinery Corp'n, Toledo, O.
Browning Co., Cleveland, O.
Bucyrus Co., South Milwaukee, Wis.
Byers Machine Co., Ravenna, Ohio.
Clyde Iron Works Sales Co., Duluth, Minn.
Economy Excavator Co., Iowa Falls, Ia.
Erie Steam Shovel Co., Erie, Pa.
Gade, C. L., Iowa Falls, Iowa.
Hayward Co., New York.
Industrial Works, Bay City, Mich.
Link-Belt Co., Chicago, Ill.
Marion Steam Shovel Co., Marion, O.
Monighan Machine Co., Chicago, Ill.
Osgood Co., Marion, O.
Parsons Co., Newton, Ia.

EXPANDED METAL

*Servicised Products Co., Chicago, Ill.
*Truscon Steel Co., Youngstown, O.
Berger Mfg. Co., Canton, O.
Consolidated Expanded Metal Co., Braddock, Pa.
Corrugated Bar Co., Inc., Buffalo, N. Y.
Northwestern Expanded Metal Co., Chicago, Ill.
Youngstown Pressed Steel, Co., Warren, O.

EXPANSION JOINT MATERIAL

*Barber Asphalt Co., Philadelphia, Pa.
*Carey Co., Philip, Cincinnati, Ohio.
*Pioneer Asphalt Co., Lawrenceville, Ill.
*Servicised Products Co., Chicago, Ill.
*Texas Company, New York.
*Truscon Steel Co., Youngstown, O.
*Waring-Underwood Co., Philadelphia, Pa.
Barrett Co., New York.

EXPLOSIVES

Atlas Powder Co., Wilmington, Del.
Du Pont de Nemours & Co., E.I., Wilmington, Del.
Giant Powder Co., Cons., San Francisco, Cal.
Hercules Powder Co., Wilmington, Del.

FENCING

Adrian Wire Fence Co., Adrian, Mich.
American Steel & Wire Co., Chicago, Ill.
Anchor Post Iron Works, New York.
Cyclone Fence Co., Waukegan, Ill.
Frost-Superior Fence Co., Cleveland, O.
Indiana Steel & Wire Co., Muncie, Ind.
Nitselman Bros., Muncie, Ind.
Michigan Wire Fence Co., Adrian, Mich.
Page Steel & Wire Co., Bridgeport, Conn.
Pittsburgh Steel Co., Pittsburgh, Pa.
Stewart Iron Works Co., Cincinnati, Ohio.
Texas Cyclone Fence Co., Fort Worth, Tex.
Wickwire Spencer Steel Corp., New York.

FILING EQUIPMENT, STEEL

Art Metal Constr. Co., Jamestown, N. Y.
Berger Mfg. Co., Canton, O.
Econ. Drawing Table & Mfg. Co., Adrian, Mich
Van Dorn Iron Works, Cleveland, O.

FILTERS, OIL

Bowser & Co., Inc., S. F., Fort Wayne, Ind.
Wayne Tank & Pump Co., Ft. Wayne, Ind.

FILTERS, WATER

American Water Softener Co., Philadelphia, Pa
Graver Corporation, E. Chicago, Ind.
International Filter Co., Chicago, Ill.
N. Y. Continental Jewel Filtr. Co., Nutley, N. J.
Norwood Engineering Co., Florence, Mass.
Roberts Filter Co., Darby, Pa.
Scaife & Sons Co., W. B., Pittsburgh, Pa.

FIRE ALARM SYSTEMS

Gamewell Fire Alarm Tel. Co., Newton Upper Falls, Mass.

FIRE ALARM SIRENS

Erick Elec. Siren Co., St. Paul, Minn.
Federal Sign System, Chicago, Ill.
Hendrie & Bolthoff Mfg. & Sup. Co., Denver, Col.
Interstate Machine Prod. Co., Rochester, N. Y.
Sirene Co., Stapleton, N. Y.
Union Water Meter Co., Worcester, Mass.

FIRE APPARATUS, MOTOR

*International Motor Co., New York.
Ahrens-Fox Fire Engine Co., Cincinnati, O.
American-La France Fire Eng. Co., Elmira, N. Y
Brockway Motor Fire App. Co., Cortlandt, N. Y.
Northern Fire Apparatus Co., Minneapolis, Minn.
Foamite-Childs Corp., Utica, N. Y.
Pirsch & Sons Co., Peter, Kenosha, Wis.
Prospect Mfg. Co., Prospect, O.
Seagrave Co., Columbus, O.
Stutz Fire Engine Co., Indianapolis, Ind.
Waterous Fire Engine Co., St. Paul, Minn.

FIRE EXTINGUISHERS, CHEMICAL

American-La France Fire Eng. Co., Elmira, N. Y.
Cross Mfg. Co., C. J., Inc., New York.
Foamite-Childs Co., Utica N. Y.
Pyrene Mfg. Co., Newark, N. J.

FIREPROOF BUILDING MATERIAL

*Truscon Steel Co., Youngstown, O.
Berger Mfg. Co., Canton, O.
Corrugated Bar Co., Inc., Buffalo, N. Y.
Delaware Clay Products Co., Pittsburgh, Pa.
Detroit Steel Prod. Co., Detroit, Mich.
General Fireproofing Co., Youngstown, O.
Keasbey & Mattison Co., Ambler, Pa.

HURLS the CONCRETE
Back~Forward~Toward the Center

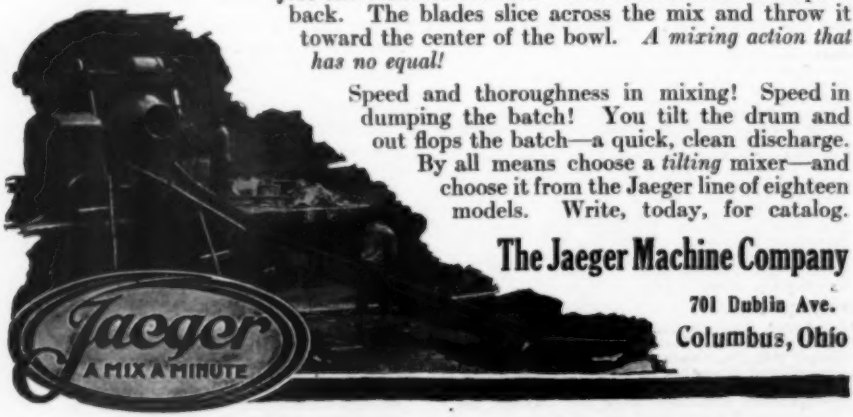
~~ the Most Perfect Mixing Action Known

The mixing action of the Jaeger is different from all others—and 18,000 users declare that none can equal it. Study the Jaeger. Make comparisons—and you'll quickly see wherein the Jaeger drum is a distinct development in mixer construction.

It is infringement to make, use or sell a patented invention without authority under the patent. Our patents have been sustained by the United States Courts in six different instances. Purchasers of our Mixers are protected.

THE Jaeger positively gives you a mix a minute. That means—one minute to the batch—*loading, mixing and discharging, all in 60 seconds.*

Only 40 seconds is required for the actual mixing. Look at the Jaeger drum to see why. Observe an exclusive Jaeger feature—two *flat surfaces* at the bottom of the drum. As the drum revolves, these flat surfaces project the concrete forward. The conical surface flops it back. The blades slice across the mix and throw it toward the center of the bowl. *A mixing action that has no equal!*



Speed and thoroughness in mixing! Speed in dumping the batch! You tilt the drum and out flops the batch—a quick, clean discharge. By all means choose a *tilting* mixer—and choose it from the Jaeger line of eighteen models. Write, today, for catalog.

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Columbus, Ohio

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National Fireproofing Co., Pittsburgh, Pa.
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Youngstown Pressed Steel, Co., Warren, O.

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*U. S. C. I. Pipe & Fdry Co., Burlington, N. J.
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Republic Creosoting Co., Indianapolis, Ind.
Sou. Wood Preserving Co., Atlanta, Ga.
Wyckoff Pipe & Creosoting Co., New York.

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Pacific Flush Tank Co., Chicago, Ill.

FLUSHERS, STREET. (See Street Flushers and Sprinklers.)

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*Truscon Steel Co., Youngstown, O.
Blaw-Knox Co., Pittsburgh, Pa.
Concrete Form Co., Inc., Syracuse, N. Y.
Heltzel Steel Form & Iron Co., Warren, O.
Hydraulic Steelcraft Co., Cleveland, O.
Lakewood Eng. Co., Cleveland, Ohio.
Metal Forms Corp., Milwaukee, Wis.

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Mott Iron Wks., J. L., New York.
Murdock Mfg. & Supply Co., Cincinnati, Ohio.
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Rundle-Spence Mfg. Co., Milwaukee, Wis.
Stewart Iron Works Co., Cincinnati, O.
Taylor Co., Halsey W., Warren, O.
Twentieth Century Brass Wks., Belleville, Ill.

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GARBAGE CANS. (See Cans)

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Four Wheel Drive Auto Co., Clintonville, Wis.
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Lee Trailer & Body Co., Chicago, Ill.
Service Motor Truck Co., Wabash, Ind.
Tiffin Wagon Co., Tiffin, O.
Watson Products Corp., Canastota, N. Y.
White Co., Cleveland, O.

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Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

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*Littleford Bros., Cincinnati, O.
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Bowser & Co., Inc., S. F., Fort Wayne, Ind.
Byers Machine Co., Ravenna, Ohio.
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Henhorst Co., Jos., Cincinnati, O.
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United Iron Works, Kansas City, Mo.
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Coffin Valve Co., Boston, Mass.
Coldwell-Wilcox Co., Newburgh, N. Y.
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Hardesty Mfg. Co., "Z", Denver, Col.

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U. S. Gauge Co., New York

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Clow & Sons, J. B., Chicago, Ill.
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United States Gauge Co., New York.
Walworth Mfg. Co., Boston, Mass.

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*Good Roads Mach'y Co., Kennett Square, Pa.
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*Stockland Road Machine Co., Minneapolis, Minn.
Adams & Co., J. D., Indianapolis, Ind.
Case Threshing Machine Co., J. I., Racine, Wis.
Kilbourne & Jacobs Mfg. Co., Columbus, O.
Lyle Culv. & Rd. Equip. Co., Minneapolis, Minn.
Shaw-Enochs Tractor Co., Minneapolis, Minn.
Smith & Sons Mfg. Co., Kansas City, Mo.

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"ONCE OVER"
ROAD FINISHERS

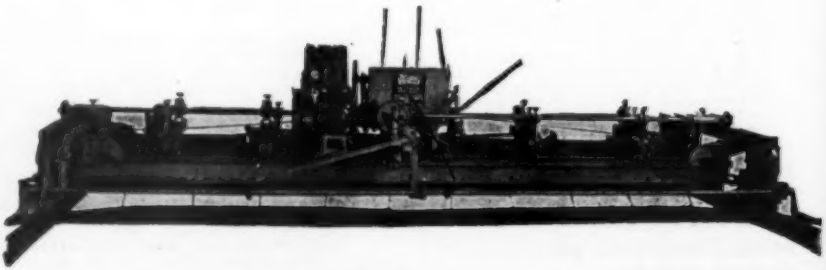
The **DUNN ROAD FINISHER** goes over the concrete O N C E only and produces a finished roadway of dense, compact concrete, free from voids and air pockets.

"ONCE OVER" means that the DUNN will handle all the concrete any Paver can turn out — thus the DUNN can always work on freshly mixed concrete, "finishing" it quickly and economically.

Use the **DUNN ROAD FINISHER** on plain or reinforced concrete roads or on base course under brick, asphalt or other top.

Strength—Durability—Economical Operation —Ability to handle any practical mix—built for any standard width of roads—These are only a few of the many features embodied in the **DUNN ROAD FINISHER.**

Send for Bulletin "F-1."



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Mead-Morrison Mfg. Co., E. Boston, Mass.
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National Hoisting Engine Co., Harrison, N. J.
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Orr & Sembower, Reading, Pa.
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Eddy Valve Mfg. Co., Waterford, N. Y.
Iowa Valve Co., Oskaloosa, Ia.
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Rice Hydraulic Engine Co., New York
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Vogt Mach. Co., Henry, Louisville, Ky.
York Mfg. Co., York, Pa.

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Allentown Testing Laboratories, Allentown, Pa.
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PAVING TOOLS
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Almost every type of street and road paving today requires the use of hot tar or asphalt in its construction. This heated material can be conveniently provided by equipping with portable tar and asphalt heaters.

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Our new catalogue of contractors' paving tools and equipment will gladly be sent on request.

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Keuffel & Esser Co., Hoboken, N. J.
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Pfister, Wm. H., Cincinnati, O.
Ulmer, J. C., Co., Cleveland, Ohio.
Weber & Co., F., Philadelphia, Pa.
White Co., David, Milwaukee, Wis.
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Stewart Iron Works Co., Cincinnati, Ohio.
Van Dorn Iron Works Co., Cleveland, O.

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(See Expansion Joint Material)

JOINTS, FLEXIBLE PIPE. (See Flexible Joints.)

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*Connery & Co., Inc., Philadelphia, Pa.
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Macleod Co., Cincinnati, O.
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General Fireproofing Co., Youngstown, O.
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Jacobsen Mfg. Co., Racine, Wis.
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Smith Mfg. Co., A. P., E. Orange, N. J.

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*Pitometer Company, New York.

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Prest-O-Lite Co., Inc., New York

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Lyle Culv. & Rd. Equip. Co., Minneapolis, Minn.
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Lima Locomotive Wks., Lima, O.
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Sargent Lumber Co., Little Rock, Ark.
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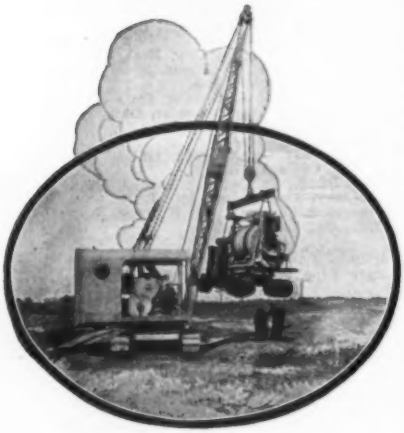
Crane Excavator

Single Lever Steering

KOEHRING CRANES are as easy steering as motor trucks. One single lever with four operating positions turns crane to right or left, or propels it forward or backward. High and low speed. The unusual, easily controlled traction ability of the Koehring on any gronnd, is a worthwhile saving of time and profit.



BOOM WITH LOAD

Elevate or lower or swing boom under load. Koehring crane construction permits this combination of functions at no penalty of extra wear or strain.

The Koehring is the only crane designed for the combining of these functions. Write for Special Bulletin.

No 2 Capacity: 12 tons at 12′ radius. ½ yard clamshell bucket loaded with sand or gravel at 45′ radius. ¾ yard clamshell bucket loaded with sand or gravel at 39′ radius. 1 yard clamshell bucket loaded with sand or gravel at 33′ radius. 1½ yard clamshell bucket loaded with sand or gravel at 24′ radius. 1 yard Page drag bucket on a 40′ boom.

No. 3 Capacity: 20 tons at 12′ radius. 1 yard clamshell bucket loaded with sand or gravel at 50′ radius. 1½ yard clamshell bucket loaded with sand or gravel at 39′ radius. 2 yard clamshell bucket loaded with sand or gravel at 33′ radius. 1½ yard Page drag bucket at 40′ radius.

No. 1 Capacity: Equipped with 30′ boom. Handles ¾ yard bucket at 23′ radius; lifting capacity at 12′, 14,000 lbs. 4 cylinder 5″ x 6″ gasoline engine

KOEHRING COMPANY, Milwaukee, Wis.

Manufacturers of Cranes, Draglines, Shovels, Concrete Mixers.
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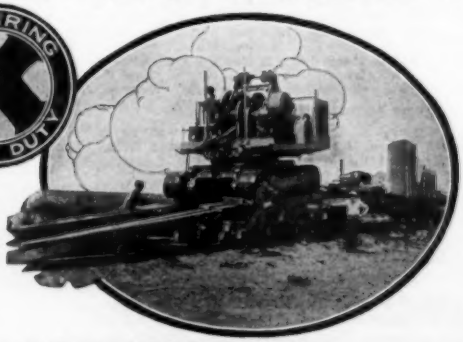

METAL LATH. (See "Lath")

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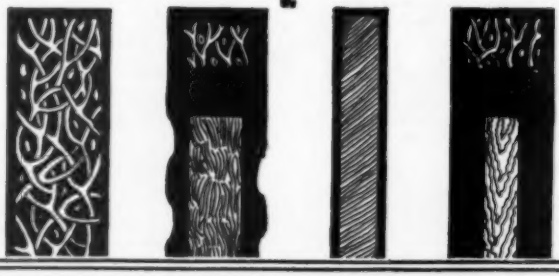
Servicised Expansion Joints



MONITORS OF THE ROAD

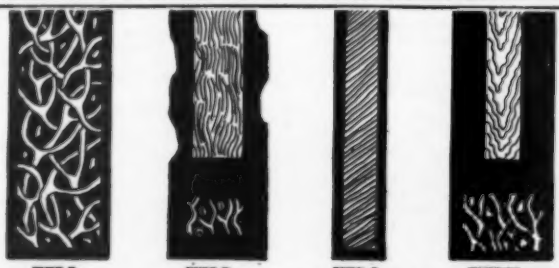
Old principles of expansion joint provide fillers of solid asphaltic content or impregnated fibre and asphalt in an elastic mass. ¶ The fundamental purpose of the filler is to re-occupy the space left by two contracting slabs. ¶ Solid asphaltic or impregnated fibrous materials contract, concrete slabs likewise contract on cooling. ¶ Three contracting bodies cannot occupy the same space as when expanded. Servicised Joints *expand* when the concrete slabs contract. ¶ This is the key to a permanent waterproof joint; a correct answer to the problem of expansion between two contracting bodies. Unimpregnated cellular fibrous matter in Servicised Joints brings about this re-expansion after compression is relieved.

Trapped Under Compression: The print to the right is an example of oozing under compression. Due to the hard asphalt surfacing over the concrete base, the traffic could not carry the surplus away because it was locked in between the asphalt surfacing and base. The force was great enough, however, to form bulges in the hard asphalt surface.

A Bituminous and Impregnated Fibre or Elastic Mass: No better proof of indiscriminate oozing. No better illustration of the need of expansion joint of the proper kind. The action in this instance resembles that of paste in a tube being squeezed with one side open. Action of this kind causes tremendous waste, without resulting in good Servicised Joints will prevent this.

Write Us About Your Expansion Joint Problems

Servicised Products Co.
First National Bank Bldg.
CHICAGO



TYPE B — 75% Bitumen 25% Cellular Fibre

TYPE D — Self-Expanding Fibre-Rubber

TYPE C — Pat. Concrete—Coated Rubber—Sidewalk Joint

TYPE AA — 3/16 Veneer Core

Four Types of Servicised Expansion Joints in Which the Oozing Tendency Is Controlled

Servicise the Crevice and Save the Road

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Massey Concrete Products Corp'n, Chicago, Ill.
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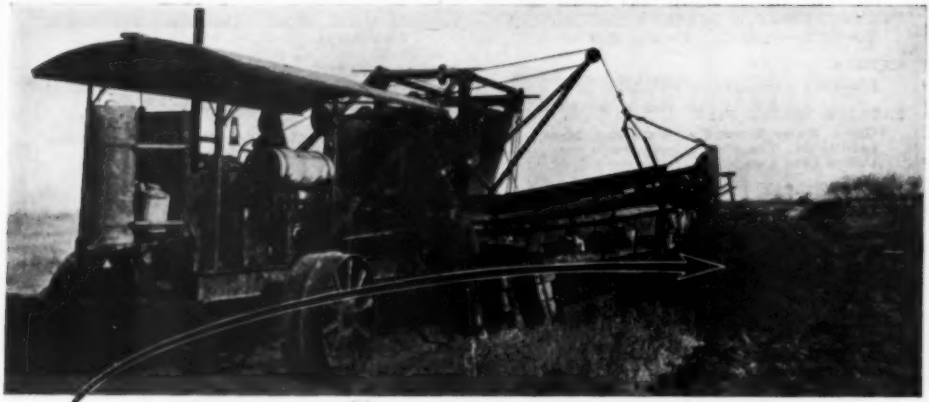

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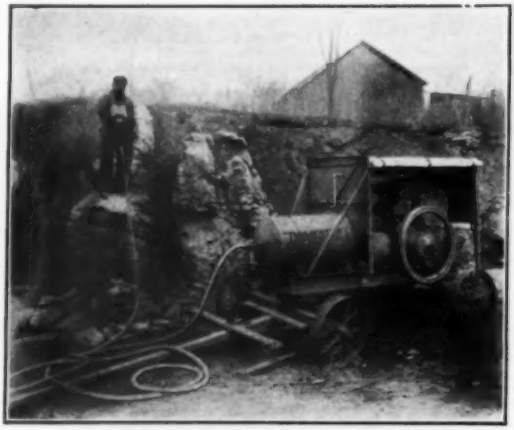

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Aurora Pump & Mfg. Co., Aurora, Ill.
Bethlehem Steel Co., Bethlehem, Pa.
Cameron Steam Pump Works, A. S., New York.
Dayton-Dowd Co., Quincy, Ill.
De Laval Steam Turbine Co., Trenton, N. J.
Erie Pump & Engine Works, Medina, N. Y.
Evinrude Motor Co., Milwaukee, Wis.
Fairbanks, Morse & Co., Chicago, Ill.
Goulds Mfg. Co., Seneca Falls, N. Y.
Indiana Air Pump Co., Indianapolis, Ind.
Lea-Courtenay Co., Newark, N. J.
Manistee Iron Wks., Manistee, Mich.
Midwest Engine Co., Indianapolis, Ind.
Morris Machine Works, Baldwinsville, N. Y.
Schramm, Inc., West Chester, Pa.
United Iron Works, Kansas City, Mo.
Wheeler Condenser & Eng. Co., Carteret, N. J.
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Yeomans Bros. Co., Chicago, Ill.

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Aurora Pump & Mfg. Co., Aurora, Ill.
Barnes Mfg. Co., Mansfield, O.
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Carter Co., Ralph B., New York.
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Dayton-Dowd Co., Quincy, Ill.
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Emerson Pump & Valve Co., Alexandria, Va.
Erie Pump & Engine Works, Medina, N. Y.
Evinrude Motor Co., Milwaukee, Wis.
Fairbanks, Morse & Co., Chicago, Ill.
Goulds Mfg. Co., Seneca Falls, N. Y.
Lea-Courtenay Co., Newark, N. J.
McGowan Co., J. R., Cincinnati, O.
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Myers & Bro. Co., F. E., Ashland, O.
Northern Fire App. Co., Minneapolis, Minn.
Novo Engine Co., Lansing, Mich.
Pulsometer Steam Pump Co., New York.
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*Keystone Driller Co., Beaver Falls, Pa.
Aldrich Pump Co., Allentown, Pa.
American Well Works, Aurora, Ill.
Cameron Steam Pump Works, A. S., New York.
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Deming Co., Salem, O.
Fairbanks, Morse & Co., Chicago, Ill.
Goulds Mfg. Co., Seneca Falls, N. Y.
Harris Air Pump Co., Indianapolis, Ind.
Indiana Air Pump Co., Indianapolis, Ind.
Layne & Bowler Co., Memphis, Tenn.
Midwest Engine Co., Indianapolis, Ind.
Myers & Bro. Co., F. E., Ashland, O.
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Weber Subterranean Pump Co., New York.

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Aurora Pump & Mfg. Co., Aurora, Ill.
Buffalo Steam Pump Co., Buffalo, N. Y.
Cameron Steam Pump Wks., A. S., New York.
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Aurora Pump & Mfg. Co., Aurora, Ill.
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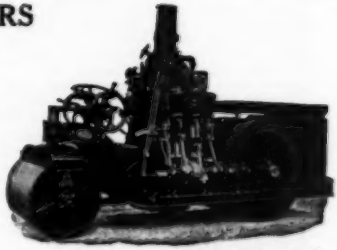

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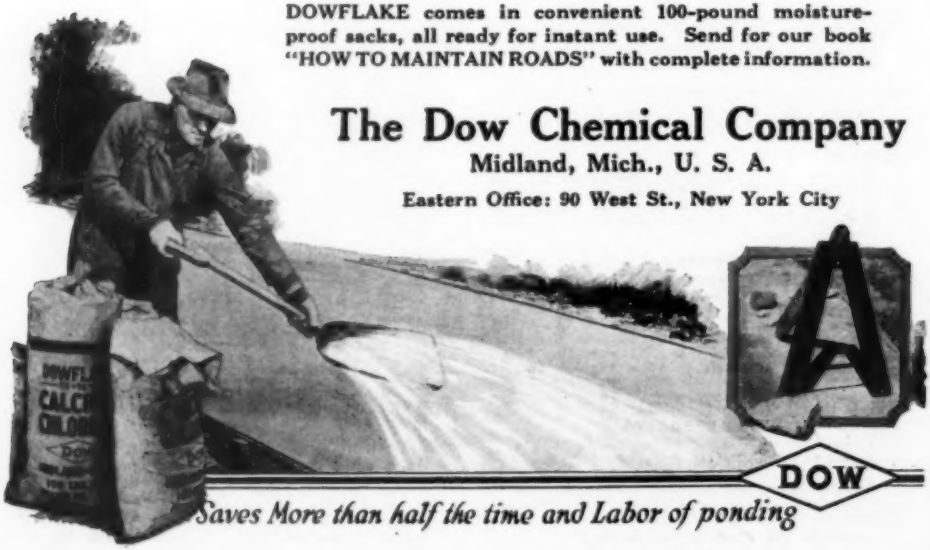

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Saves More than half the time and Labor of ponding

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Mound Traffic Equip. Co., Columbus, O.
Safety Traffic Lt. Co., Milwaukee, Wis.
Thomson Bros., Chicago, Ill.
Thompson-Fleming, Inc., Buffalo, N. Y.
Union Iron Products Co., E. Chicago, Ind.

SLATE, ROOFING

Vendor Slate Co., Inc., Easton, Pa.

SLATE, STRUCTURAL

Penna. Structural Slate Co., Easton, Pa.
Phœnix Slate Co., Windgap, Pa.
Structural Slate Co., Pen Argyl, Pa.

SLEEVES, TAPPING AND VALVE

Mueller Mfg. Co., Decatur, Ill.
Rensselaer Valve Co., Troy, N. Y.
Smith Mfg. Co., A. P., East Orange, N. J.

SLUICE GATES. (See Gates, Sluice.)

SMOKE STACKS. (See Stacks, Steel)

SNOW CLEANING MACHINERY

*Austin-Western Road Mchy. Co., Chicago, Ill.
*Baker Mfg. Co., Springfield, Ill.
*Good Roads Mach. Co., Kennett Square, Pa.
*Holt Mfg. Co., Peoria, Ill.
*International Motor Co., New York.
*Monarch Tractors, Inc., Watertown, Wis.
Avery Co., Peoria, Ill.
Barber-Greene Co., Aurora, Ill.
Cleveland Tractor Co., Cleveland, Ohio.
Toy Co., W. M., Sidney, Ohio.
J. T. Tractor Co., Cleveland, O.
Owensboro Ditcher & Grader Co., Owensboro, Ky.

SPRAYING MACHINERY

Bean Spray Pump Co., Lansing, Mich.
Deming Co., The, Salem, Ohio.
Field Force Pump Co., Elmira, N. Y.
Fitzhenry-Guptill Co., Boston, Mass.

SPREADERS, STONE

*Austin-Western Road Mchy. Co., Chicago, Ill.
*Burch Plow Works Co., Crestline, O.

STACKS, STEEL

*Connery & Co., Inc., Philadelphia, Pa.
*Heil Co., The, Milwaukee, Wis.
*Littleford Bros., Cincinnati, O.
Blaw-Knox Co., Pittsburgh, Pa.
Chatta. Boiler & Tank Co., Chattanooga, Tenn
Chicago Bridge & Iron Works, Chicago, Ill.
Honhorst Co., Jos., Cincinnati, O.
Petroleum Iron Works Co., Sharon, Pa.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Scaife & Sons Co., Wm. B., Pittsburgh, Pa.
Walsh & Weidner Boiler Co., Chattanooga, Tenn

STEAM SHOVELS. (See Shovels, Steam)

STANDPIPES, TANKS AND TOWERS

*Connery & Co., Inc., Philadelphia, Pa.
Caldwell Co., W. E., Louisville, Ky.
Chattanooga Blr. & Tank Co., Chattanooga, Tenn.
Chicago Bridge & Iron Works, Chicago, Ill.
Lancaster Iron Wks., Lancaster, Pa.
Pacific Tank & Pipe Co., San Francisco, Cal.
Petroleum Iron Works Co., Sharon, Pa.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
United Iron Works, Kansas City, Mo.
Walsh & Weidner Boiler Co., Chattanooga, Tenn.

STEAM TURBINES

Allis-Chalmers Mfg. Co., Milwaukee, Wis.
De Laval Steam Turbine Co., Trenton, N. J.
Ingersoll-Rand Co., New York.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

STEEL PLATE CONSTRUCTION

*Connery & Co., Philadelphia, Pa.
*Heil Co., The, Milwaukee, Wis.
*Littleford Bros., Cincinnati, O.
Bethlehem Steel Co., Bethlehem, Pa.
Biggs Boiler Wks., Akron, O.
Birmingham Steel Corp., Birmingham, Ala.
Blaw-Knox Co., Pittsburgh, Pa.
Chatta. Boiler & Tank Co., Chattanooga, Tenn.
Chicago Bridge & Iron Works, Chicago, Ill.
Graver Corporation, E. Chicago, Ind.
Heltzel Steel Form & Iron Co., Warren, O.
Hendrick Mfg. Co., Carbondale, Pa.
Honhorst Co., Jos., Cincinnati, Ohio.
McClintic-Marshall Co., Pittsburgh, Pa.
Pennsylvania Bridge Co., Beaver Falls, Pa.
Petroleum Iron Works Co., Sharon, Pa.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Riter-Conley Co., Pittsburgh, Pa.
Scaife & Sons, Wm. B., Pittsburgh, Pa.
Toledo Crane Co., Toledo, O.
Union Iron Works, Hoboken, N. J.
Vulcan Iron Works, Jersey City, N. J.
Walsh & Weidner Boiler Co., Chattanooga, Tenn.

STOKERS, MECHANICAL

Automatic Furnace Co., Dayton, Ohio.
Babcock & Wilcox Co., New York
Combustion Engine Corp., New York
Detroit Stoker Co., Detroit, Mich.
Laclede-Christy Clay Prod. Co., St. Louis, Mo.
Murphy Iron Works, Detroit, Mich.
Sanford Riley Stoker Co., Worcester, Mass.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

STREET AND ROAD SIGNS. (See Signs, Street and Road.)

STREET CLEANERS' CARTS

*Rochester Can Co., Rochester, N. Y.
Durlach Can & Iron Works, Brooklyn, N. Y.
Tarrant Mfg. Co., Saratoga Springs, N. Y.

STREET FLUSHERS AND SPRINKLERS

*Austin-Western Road Machy. Co., Chicago, Ill.
*General Motors Truck Co., Pontiac, Mich.
*Heil Co., The, Milwaukee, Wis.
*International Motor Co., New York.
*Municipal Supply Co., South Bend, Ind.
Autocar Co., Ardmore, Pa.
Etnyre & Co., E. D., Oregon, Ill.
Federal Motor Truck Co., Detroit, Mich.
Packard Motor Car Co., Detroit, Mich.
Pierce Arrow Motor Car Co., Buffalo, N. Y.
Tiffin Wagon Co., Tiffin, O.
White Co., Cleveland, O.

STREET LAMP POSTS

Clow & Sons, J. B., Chicago, Ill.
Drake Mfg. Co., Friendship, N. Y.
Electric Railway Equipment Co., Cincinnati, O.
General Electric Co., Schenectady, N. Y.
King Mfg. Co., Chicago, Ill.
Massey Concrete Products Co., Chicago, Ill.
Mott Iron Wks., J. L., New York
Union Metal Mfg. Co., Canton, O.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

STREET SIGNS (See Signs, Street)

STREET SWEEPERS

*Austin-Western Road Mchy. Co., Chicago, Ill.
*Good Roads Mach. Co., Kennett Square, Pa.
*Universal Road Machinery Co., Kingston, N. Y.
Elgin Sales Corp'n, New York.
Springfield Motor Sweeper Co., Springfield, O.
Tiffin Wagon Co., Tiffin, O.

STRUCTURAL STEEL AND IRON. (See Bridges and Buildings)

STUMP PULLERS

Bennett & Co., H. L., Westerville, O.
Clyde Iron Works, Duluth, Minn.
La Plant-Choate Mfg. Co., Cedar Rapids, Ia.
Thomas Elevator Co., Chicago, Ill.

SUPERHEATERS

Babcock & Wilcox Co., New York.
Power Specialty Co., New York.
Superheater Co., New York.

SURVEYORS' INSTRUMENTS. (See Instruments.)

SWITCHBOARDS

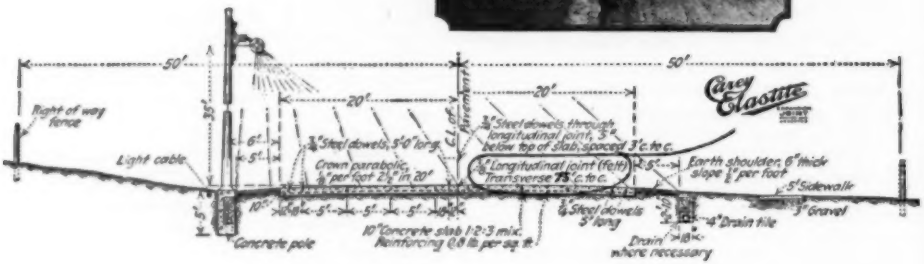
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.
Wagner Elec. Mfg. Co., St. Louis, Mo.
Westinghouse Elec. & Mfg.Co.,E. Pittsburgh, Pa.

TABLES AND BOARDS, DRAWING. (See Drawing Materials.)

TAMPING MACHINES

*Pawling & Harnischfeger Co., Milwaukee, Wis.
Construction Mach'y Co., Waterloo, Ia.
Ingersoll-Rand Co., New York

The "Ideal Section" of the Lincoln Highway near Dyer, Indiana. Stone & Webster, Boston, Mass., Engineering Contractors in charge of construction, assisted by Lockwood, Green & Co., Detroit, Mich., Consulting Engineers. Jen Jensen, Chicago, Ill., Landscaping. J. C. O'Connor & Sons, Fort Wayne, Ind., Contractors. Carey Elastite Expansion Joint used as transverse and longitudinal joints.



Carey Elastite Expansion Joint chosen for the "Ideal Section"

Features of the "Ideal Section"

Standard width of right-of-way, 100 feet. Paving width, 40 feet. Four traffic lanes. Accommodation for 15,000 passenger automobiles per 24 hour day at 35 miles per hour, and 5,000 motor trucks every 24 hours at 10 miles per hour. Thickness of concrete, 10 inches, reinforced with 80 lb. steel per 100 sq. ft. No curves less than 1,000 feet radius. Curves super-elevated for speed of 35 miles per hour. Crossings at grade eliminated. Foot-path for pedestrians. Embankments over 3 feet high guarded by rail. Uniform markers for distance and direction. Comfort station and a camp site acreage. Special illumination for night driving. Wiring carried in underground cables. Drainage taken care of underground; no open ditches.

THE Ideal Section of the Lincoln Highway is a one and one-half mile length between Dyer and Schererville, Ind., 32 miles south of Chicago.

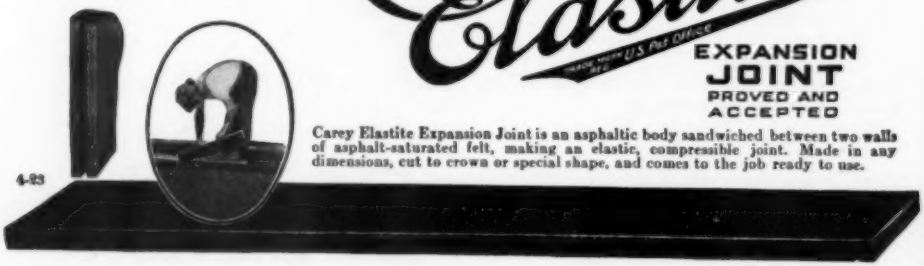
"Its proponents," writes Mr. W. G. Thompson, Consulting Engineer for the Ideal Section, "do not set it up as a pattern to be minutely followed, but as a guide, hoping that the general principles may be adopted and improved on when routes of heavy travel are being considered."

Ideas secured from questionnaires to 4,600 highway engineers are embodied in the design.

Carey Elastite Expansion Joint is used in the "Ideal Section" as transverse joints every 75 feet and is also used as a longitudinal center joint.

THE PHILIP CAREY COMPANY
9 Wayne Avenue, Lockland, Cincinnati, Ohio

Made like a sandwich installed like a board



Carey Elastite
EXPANSION JOINT
PROVED AND ACCEPTED

Carey Elastite Expansion Joint is an asphaltic body sandwiched between two walls of asphalt-saturated felt, making an elastic, compressible joint. Made in any dimensions, cut to crown or special shape, and comes to the job ready to use.

4-23

TANKS, AIR COMPRESSOR

*Connery & Co., Inc., Philadelphia, Pa.
*Heil Co., Milwaukee, Wis.
*Littleford Bros., Cincinnati, O.
Abendroth & Root Mfg. Co., New York.
Biggs Boiler Wks., Akron, O.
Graver Corporation, E. Chicago, Ind.
Indiana Air Pump Co., Indianapolis, Ind.
Chicago Bridge & Iron Works, Chicago, Ill.
Ingersoll-Rand Co., New York.
Lancaster Iron Wks., Lancaster, Pa.
National Tube Co., Pittsburgh, Pa.
Petroleum Iron Works Co., Sharon, Pa.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Scaife & Sons Co., W. B., Pittsburgh, Pa.
Westinghouse Tract. Brake Co., Wilmerding, Pa.
Worthington Pump & Machy. Corp., New York.

TANKS FOR OIL

*Connery & Co., Philadelphia, Pa.
*Heil Co., Milwaukee, Wis.
*Littleford Bros., Cincinnati, O.
Biggs Boiler Works Co., Akron, O.
Bowser & Co., Inc., S. F., Fort Wayne, Ind.
Chatta. Boiler & Tank Co., Chattanooga, Tenn.
Chicago Bridge & Iron Works, Chicago, Ill.
Dover Boiler Works, New York.
Foute Co., C. C., Middletown, O.
Graver Corporation, E. Chicago, Ind.
Honhorst Co., Jos., Cincinnati, Ohio.
Pacific Tank & Pipe Co., San Francisco, Cal.
Petroleum Iron Works Co., Sharon, Pa.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Riter-Conley Co., Pittsburgh, Pa.
Scaife & Sons Co., Wm. B., Pittsburgh, Pa.
United Iron Works, Kansas City, Mo.
Walsh & Weidner Boiler Co., Chattanooga, Tenn.
Wayne Tank & Pump Co., Ft. Wayne, Ind.

TANKS, STEEL

*Connery & Co., Philadelphia, Pa.
*Heil Co., Milwaukee, Wis.
*Littleford Bros., Cincinnati, O.
Avery Co., Peoria, Ill.
Biggs Boiler Wks., Akron, O.
Case Threshing Mach. Co., J. I., Racine, Wis.
Caldwell Co., W. E., Louisville, Ky.
Chatta. Boiler & Tank Co., Chattanooga, Tenn.
Chicago Bridge & Iron Works, Chicago, Ill.
Columbian Steel Tank Co., Kansas City, Mo.
Graver Corporation, E. Chicago, Ind.
Hardesty Mfg. Co., R., Denver, Col.
Hendrick Mfg. Co., Carbondale, Pa.
Honhorst Co., Jos., Cincinnati, Ohio.
Lancaster Iron Works, Lancaster, Pa.
Petroleum Iron Works Co., Sharon, Pa.
Pittsburgh-Des Moines Steel Co., Pittsburgh, Pa.
Scaife & Sons, Wm. B., Oakmont, Pa.

TANKS, WOOD

Caldwell Co., W. E., Louisville, Ky.
Davis & Son, G. M., Palatka, Fla.
Eagle Tank Co., Chicago, Ill.
Hauser-Stander Tank Co., Cincinnati, O.
Kalamazoo Tank & Silo Co., Kalamazoo, Mich.
National Tank & Pipe Co., Portland, Ore.
Pacific Tank & Pipe Co., San Francisco, Cal.
Redwood Manufacturers Co., San Francisco, Calif.
Stearns Lumber Co., A. T., Boston, Mass.
U. S. Wind Engine & Pump Co., Batavia, Ill.
Wendnagel & Co., Chicago, Ill.

TANK WAGONS

*Heil Co., Milwaukee, Wis.
*International Motor Co., New York.
Acme Road Mach. Co., Frankfort, N. Y.
Avery Co., Peoria, Ill.
Case Threshing Mach. Co., J. I., Racine, Wis.

TAPES, STEEL AND METALLIC

Dietzgen Co., Eugene, New York.
Keuffel & Esser Co., Hoboken, N. J.
Lufkin Rule Co., Saginaw, Mich.
Starrett, L. S., Athol, Mass.

TAPPING MACHINES

Hays Mfg. Co., Erie, Pa.
Mueller Mfg. Co., H., Decatur, Ill.
Smith Mfg. Co., A. P., E. Orange, N. J.
American Tar Products Co., Chicago, Ill.

TAR

Barrett Co., New York.

TAR KETTLES. **(See Kettles)**

TIES, STEEL

*Koppel Ind. Car & Equip. Co., Koppel, Pa.
Carnegie Steel Co., Pittsburgh, Pa.
Sweet's Steel Co., Williamsport, Pa.

TIMBER CLAMPS

Pyle-Rogers Corp., New York.

TIRES, RUBBER. **(For Motor Trucks.)**

Firestone Tire & Rubber Co., Akron, O.
Fisk Tire Co., Akron, O.
Goodrich Rubber Co., B. F., Akron, O.
Goodyear Tire & Rubber Co., Akron, O.
Kelly Springfield Tire Co., New York.
Republic Rubber Co., Youngstown, O.
U. S. Tire Co., New York.

TOOL HOUSES, PORTABLE STEEL

*Littleford Bros., Cincinnati, O.

TOWERS **(See Standpipe Tanks and Towers)**

TRACKS, INDUSTRIAL AND PORTABLE

*Koppel Ind. Car & Equip. Co., Koppel, Pa.
Atlas Car & Mfg. Co., Cleveland, Ohio.
Bethlehem Steel Co., Bethlehem, Pa.
Chase Fdry. & Mfg. Co., Columbus, O.
Easton Car & Constn. Co., New York.
Hunt Co., Inc., C. W., West New Brighton, N. Y.
Lakewood Engineering Co., Cleveland, O.

TRACTORS

*Best Tractor Co., C. L., San Leandro, Cal.
*Cleveland Tractor Co., Cleveland, O.
*Holt Mfg. Co., Peoria, Ill.
*International Motor Co., New York.
*Monarch Tractors, Inc., Watertown, Wis.
Advance-Rumely Thresher Co., Laporte, Ind.
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Avery Co., Peoria, Ill.
Barrett-Cravens Co., Chicago, Ill.
Bates Machine & Tractor Co., Joliet, Ill.
Case Threshing Machine Co., J. I., Racine, Wis.
Clark Trucktractor Co., Chicago, Ill.
Dayton-Dowd Co., Quincy, Ill.
Fairbanks, Morse & Co., Chicago, Ill.
Four Wheel Drive Auto Co., Clintonville, Wis.
Hart-Parr Co., Charles City, Iowa.
Huber Mfg. Co., Marion, O.
International Harvester Co., Chicago, Ill.
J. T. Tractor Co., Cleveland, O.
Little Giant Co., Mankato, Minn.
Moline Plow Co., Rock Island, Ill.
Oliver Tractor Co., Knoxville, Tenn.
Shaw-Enochs Tractor Co., Minneapolis, Minn.
Twin City Co., Minneapolis, Minn.
White Company, The, Cleveland, O.

TRAFFIC PAINT

Hoosier Paint Wks., Ft. Wayne, Ind.
Tropical Paint & Oil Co., Cleveland, Ohio.
Truscon Laboratories, Detroit, Mich.

TRAFFIC SIGNS. **(See "Signs, Traffic")**

TRAILERS FOR TRUCKS AND TRACTORS

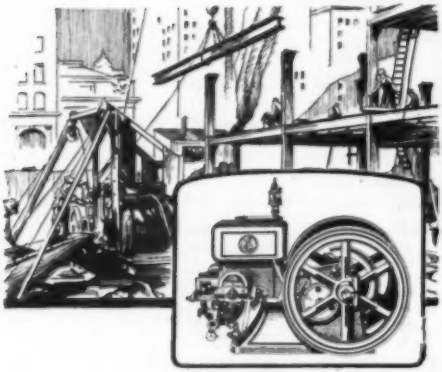
Arcadia Trailer Corp., Newark, N. Y.
Eagle Wagon Works, Auburn, N. Y.
Highway Trailer Co., Edgerton, Wis.
La Plant-Choate Mfg. Co., Cedar Rapids, Ia.
Lee Trailer & Body Co., Chicago, Ill.
Troy Wagon Works, Troy, O.
Warner Mfg. Co., Beloit, Wis.
Watson Products Corp'n., Canastota, N. Y.

TRAILERS, INDUSTRIAL

Chase Fdry. & Mfg. Co., Columbus, O.
Electric Wheel Co., Quincy, Ill.
Lakewood Engineering Co., Cleveland, O.
Lee Trailer & Body Co., Chicago, Ill.

TRAMWAYS, AERIAL WIRE ROPE

Broderick & Bascom Rope Co., St. Louis, Mo.
Leschen & Sons Rope Co., A., St. Louis, Mo.



"Hercules Equipped" is Guaranteed Mixer Service

The heart of the mixer is the engine that drives it. When that balks—it makes no difference how mechanically perfect the mixer may be otherwise—it is as lifeless as scrap iron.

The mixer that is "Hercules-equipped" has guaranteed power. Behind every one of the 350,000 Hercules Engines in use, is the five-year guarantee of the Hercules Corporation. Every one of them is the same in sturdiness of construction, in careful workmanship.

The Hercules is made to work in all weathers. Equipped with the latest type of magneto, it is easy starting, dependable and sure.

Whatever power-driven equipment you need, whether it be a concrete mixer, a saw rig, hoist, air compressor conveyor or crusher, see to it that is has dependable Hercules power.

Write for our engine book and price list. We will gladly advise you about your power problems.

The Hercules Corporation

Engine Division, Dept. B, Evansville, Indiana

HERCULES ENGINES

CLIPPER The Drill That DRILLS **Drill**

Steam
Gasoline
Electric

THE CONTRACTOR'S GREATEST FRIEND!

Used by the largest buyers of Drilling Machinery in the World!

Used for drilling Blast Holes, Test Holes, Air Holes, Water Wells, etc. The Machine that *can be depended on!*

Write describing your work.

The Loomis Machine Company

TIFFIN, OHIO

Good News!

You bet this is good news for the Road Contractor for Heil is offering him the best buy in Gravity Dump Bodies on the market today. $80.00 (5% for tax) will buy this Heil Quality one yard Gravity Body complete. 80 degree dumping angle. Electrically welded, making it watertight. Units in stock for immediate shipment.

Write us today about it.

THE HEIL CO.

1243 - 26th Avenue, Milwaukee, Wis.

Builders of Steel Dump Bodies, Hydro Hoists and Welded Compartment, Pressure and Storage Tanks.

TRANSFORMERS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
General Electric Co., Schenectady, N. Y.
Kuhlman Electric Co., Bay City, Mich.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

TRANSITS AND LEVELS. (See Instruments.)

TRANSMISSION MACHINERY, POWER
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Chain Belt Co., Milwaukee, Wis.
Dodge Mfg. Co., Mishawaka, Ind.
General Electric Co., Schenectady, N. Y.
Link-Belt Co., Chicago, Ill.
Webster Mfg. Co., Chicago, Ill.
Weller Mfg. Co., Chicago, Ill.

TRASH CANS. (See Cans)

TREADS, SAFETY
American Abrasive Metals Co., New York.
American Mason Safety Tread Co., Lowell, Mass.
Concrete Steel Co., New York.
Hendrick Mfg. Co., Carbondale, Pa.
Norton Co., Worcester, Mass.

TRENCH BRACES. (See Braces, Trench)

TRENCH EXCAVATORS, (see Excavators, Ditch & Trench)

TRENCH PUMPS. (See Pumps, Contractors')

TURBINES
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
De Laval Steam Turbine Co., Trenton, N. J.
General Electric Co., Schenectady, N. Y.
Ingersoll-Rand Co., New York.
Midwest Engine Co., Indianapolis, Ind.
Westinghouse Elec. & Mfg. Co., E. Pittsb'gh, Pa.

TURNTABLES FOR MOTOR TRUCKS
Blaw-Knox Co., Pittsburgh, Pa.
Champion Eng. Co., Kenton, O.
Hug Co., Highland, Ill.
Western Structural Co., Moline, Ill.

USED MACHINERY
(See Contractors' Used Equipment.)

VALVE CONTROL APPARATUS, ELECTRIC
Payne Dean, Ltd., New York.

VALVES, GATE AND INDICATOR POSTS
*Ludlow Valve Mfg. Co., Troy, N. Y.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Columbian Iron Wks., Chattanooga, Tenn.
Crane Company, Chicago, Ill.
Darling Valve & Mfg. Co., Williamsport, Pa.
Eddy Valve Co., Waterford, N. Y.
Fairbanks Co., The, New York.
Iowa Valve Co., Oskaloosa, Ia.
Kennedy Valve Mfg. Co., Elmira, N. Y.
Lunkenheimer Co., Cincinnati, O.
Reading Steel Casting Co., Inc., Bridgeport, Conn.
Rensselaer Valve Co., Troy, N. Y.
Smith Mfg. Co., A. P., East Orange, N. J.
Wood & Co., R. D., Philadelphia, Pa.

VALVE BOXES AND HOUSINGS
*Central Foundry Co., New York.
*Clark Co., H. W., Mattoon, Ill.
*Ludlow Valve Co., Troy, N. Y.
*U. S. C. Ir. Pipe & Fdry. Co., Burlington, N. J.
Chapman Valve Mfg. Co., Indian Orchard, Mass.
Clow & Sons, J. B., Chicago, Ill.
Columbian Iron Works, Chattanooga, Tenn.
Darling Valve & Mfg. Co., Williamsport, Pa.
Eddy Valve Co., Waterford, N. Y.
Fairbanks Co., The, New York.
Iowa Valve Co., Oskaloosa, Ia.
Kennedy Valve Mfg. Co., Elmira, N. Y.
Mueller Mfg. Co., H., Decatur, Ill.
Pratt & Cady Co., Inc., Hartford, Conn.
Rensselaer Valve Co., Troy, N. Y.
Smith Mfg. Co., A. P., East Orange, N. J.
S. E. T. Valve & Hydrant Co., New York.
Wood & Co., R. D., Philadelphia, Pa.

VENTILATORS
American Blower Co., Detroit, Mich.
Edwards Mfg. Co., Cincinnati, O.
Milwaukee Corrugating Co., Milwaukee, Wis.

WAGONS. (See Dump Carts and Wagons.)

WAGON BODIES. (See Dump Bodies)

WAGON LOADERS. (See Loaders, Gravel and Wagon)

WALLBOARD
*Carey Co., Philip, Cincinnati, Ohio.
Beaver Board Companies, Buffalo, N. Y.
Bird & Son, Inc., E. Walpole, Mass.
Cornell Wood Products Co., Chicago, Ill.
Haverhill Box Board Co., Haverhill, Mass.
MacAndrews & Forbes Co., New York, N. Y.
Plastergon Wall Board Co., Buffalo, N. Y.
United States Gypsum Co., Chicago, Ill.
Upson Co., The, Lockport, N. Y.
Waldorf Paper Products Co., St. Paul, Minn.

WALL TIES
Concrete Steel Co., New York, N. Y.
Consolidated Expanded Metal Co., Braddock, Pa.
Berger Mfg. Co., Canton, O.
Milwaukee Corrugating Co., Milwaukee, Wis.
Niagara Metal Stamp. Corp., Niagara Falls, N. Y.

WATER MAIN CLEANING
*National Water Main Cleaning Co., New York.

WATER MAIN TAPPING MACHINES
Mueller Mfg. Co., H., Decatur, Ill.
Smith Mfg. Co., A. P., East Orange, N. J.

WATER METERS. (See Meters, Water.)

WATERPROOFING COMPOUNDS AND MATERIAL
*Barber Asphalt Co., Philadelphia, Pa.
*Carey Co., Philip, Cincinnati, Ohio.
*Servicised Products Co., Chicago, Ill.
*Standard Oil Co. (Indiana), Chicago, Ill.
*Texas Company, New York.
Anti-Hydro Waterproofing Co., Newark, N. J.
Atlantic Refining & Asphalt Corp., Phil'a, Pa.
Barrett Company, New York.
General Fireproofing Co., Youngstown, O.
Master Builders' Co., Cleveland, O.
Minwax Co., The, New York.
Protexol Corpn., New York.
Ruberoid Co., New York.
Sonneborn Sons, Inc., New York.
Tock Brothers, New York.
Truscon Laboratories, Detroit, Mich.

WATER PURIFICATION. (See also Filters.)
*Wallace & Tiernan Co., Inc., Newark, N. J.
Electro Bleaching Gas Co., New York.
Mathieson Alkali Works, Inc., New York.
Penna. Salt Mfg. Co., Philadelphia, Pa.
R. U. V. Company, New York.

WATER REGULATORS
*Union Water Meter Co., Worcester, Mass.
Mueller Mfg. Co., Decatur, Ill.
Pacific Flush Tank Co., Chicago, Ill.

WATER SOFTENERS
American Water Softener Co., Philadelphia, Pa.
Graver Corporation, E. Chicago, Ind.
International Filter Co., Chicago, Ill.
N. Y. Continental Jewell Filtr. Co., Nutley, N. J.
Permutit Company, New York.
Roberts Filter Mfg. Co., Darby, Pa.
Scaife & Sons, W. B., Pittsburgh, Pa.
Wayne Tank & Pump Co., Ft. Wayne, Ind.

WATER WHEELS
Allis-Chalmers Mfg. Co., Milwaukee, Wis.
Leffel & Co., Jas., Springfield, O.
Pelton Water Wheel Co., San Francisco, Cal.
Smith Company, S. Morgan, York, Pa.

There should be more to a wheelbarrow than simply a tray, with a wheel, leg and a couple of sticks hitched on. More than just any old perambulator built to sell cheap. That's why Sterling wheels have 10 spokes and self-lubricating bearings. Why the leg is riveted instead of bolted. Why shoes are riveted to the leg. Why handle clamps are used instead of bolts. These are the little differences which make Sterling barrows better than just plain WHEELBARROWS.

Sterling Wheelbarrow Company

NEW YORK
BOSTON
CLEVELAND
BUFFALO

MILWAUKEE, WIS.

CANADIAN AGENTS—FROST & WOOD LIMITED, MONTREAL, TORONTO, WINNIPEG, VANCOUVER

DETROIT
CHICAGO
ST. LOUIS
SPOKANE

WELDING APPARATUS

General Electric Co., Schenectady, N. Y.
Milburn Company, Alex., Baltimore, Md.
Oxweld Acetylene Co., Newark, N. J.

WELL SCREENS

Cook, Inc., A. D., Lawrenceburg, Ind.
Johnson, Edw. E., Inc., St. Paul, Minn.

WELL-DRILLING AND BLAST HOLE MACHINES

*Keystone Driller Co., Beaver Falls, Pa.
*Loomis Machine Co., Tiffin, O.
American Well Works, Aurora, Ill.
Armstrong Mfg. Co., Waterloo, Iowa.
Leidecker Tool Co., Marietta, Ohio.
Sanderson Cyclone Drill Co., Orrville, Ohio.
Sparta Iron Wks. Co., Sparta, Wis.
Star Drilling Machine Co., Akron, O.

WHEELBARROWS

*Sterling Wheelbarrow Co., Milwaukee, Wis.
Akron Barrow Co., Cleveland, O.
Jackson Mfg. Co., Harrisburg, Pa.
Kilbourne & Jacobs Mfg. Co., Columbus, O.
Lansing Co., Lansing, Mich.
Sidney Steel Scraper Co., Sidney, O.
Steubner Iron Wks., G. L., L. I. City, N. Y.
Toledo Wheelbarrow Co., Toledo, O.

WINCHES

Bethlehem Shipbuilding Corp., Bethlehem, Pa.
Chisholm-Moore Mfg. Co., Cleveland, O.
Clyde Iron Wks., Duluth, Minn.
Dobbie Fdry. & Mach. Co., Niagara Falls, N. Y.
Lidgerwood Mfg. Co., New York.
Mead-Morrison Mfg. Co., E. Boston, Mass.
Mundy Hoisting Eng. Co., J. S., Newark, N. J.

WINDOW FRAMES AND SASH. (Metallic.)

*Truscon Steel Co., Youngstown, O.
Bayley Co., Wm., Springfield, O.
Detroit Steel Products Co., Detroit, Mich.
Friedrich Co., E. H., Holyoke, Mass.
Lupton's Sons Co., David, Philadelphia, Pa.
McFarland Co., J. C., La Porte, Ind.
Penn Metal Co., Boston, Mass.
Sykes Co., Chicago, Ill.

WIRE AND CABLE

American Steel & Wire Co., Chicago, Ill.
General Electric Co., Schenectady, N. Y.
Habirshaw Elec. Cable Co., Inc., N. Y. C.
Hazard Mfg. Co., Wilkesbarre, Pa.
Macwhyte Co., Kenosha, Wis.
National India Rubber Co., Bristol, R. I.
New York Insulated Wire Co., New York.
Okonite Co., Passaic, N. J.
Roebling's Sons Co., J. A., Trenton, N. J.
Safety Ins. Wire & Cable Co., New York.
Simplex Wire & Cable Co., Boston, Mass.
Standard Underground Cable Co., Pittsburgh, Pa.
Tubular Woven Fabric Co., Pawtucket, R. I.
Waterbury Co., New York.

WIRE GLASS

Mississippi Wire Glass Co., New York.

WIRE MESH REINFORCEMENT

*Truscon Steel Co., Youngstown, O.
American Steel & Wire Co., Chicago, Ill.
National Steel Fabric Co., Pittsburgh, Pa.
Wickwire Spencer Steel Corp., New York.

WIRE ROPE. (See Rope, Wire.)

WOOD BLOCKS (See Paving Blocks)

WOODWORKING MACHINES

*Ransome Concrete Mach. Co., Dunellen, N. J.
Fairbanks, Morse & Co., Chicago, Ill.

WOOD PRESERVATIVES

Barrett Company, New York.
General Chemical Co., New York.
Protexol Corpn., New York.
Republic Creosoting Co., Indianapolis, Ind.
Truscon Laboratories, Detroit, Mich.

WRECKING BARS

*Anderson Bros. Mfg. Co., Rockford, Ill.

WRENCHES

Erie Tool Works, Erie, Pa.
Greene, Tweed & Co., New York.
Greenfield Tap & Die Corp., Greenfield, Mass.
Lowell Wrench Co., Worcester, Mass.

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On Trucks with Gasoline Engine, Power Loader and Automatic Water Tank

Part for part and job for job the only mixer that will beat this 7-S Ransome Mixer is a larger Ransome. And the price is *little if any* more than that of an *ordinary* mixer of this size.

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All-steel drum made of 3/16" tank plate.

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Main rollers 12" in diameter by 2½" face with 8" hub.

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H. P gasoline engine, 6.

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Quick Work in Extending a Water-Works Intake

A 504-Foot Extension Laid from the Ice

By V. Flindt
Engineer, Storm Lake Water Committee, Iowa

IT would probably be very difficult to find an engineering undertaking which would demand greater promptness in execution than the extension of the Storm Lake water-works intake, 504 feet into the lake, laying the pipe from the ice. There is a possible exception in construction work carried on in connection with war operations. The end of the old intake, a 12-inch wrought iron pipe, was located 297 feet from the lake shore in 5 feet of water. The proposed end was to be 801 feet from the shore in 8 feet of water.

When the ice is not unusually thick, it disappears very quickly at the intake, shortly after the weather turns warm. The complete success of the undertaking might have been, therefore, not a question of days, but of hours, and such was the case in this operation. The great trouble which the city experienced this last summer with green algae in the drinking water, was largely caused by the intake's being too close to the shore. The City Council, therefore, decided to use the first opportunity to construct an extension.

Different kinds of pipe and construction methods were investigated during the summer, with the result that the engineers suggested Universal pipe, manufactured by the Central Foundry Company of New York, the pipe to be laid from the ice. The reason for choosing this special pipe was the flexibility of the joints, the speed with which the pipe lengths could be put together, there being only two bolts to tighten at each joint, and the ease with which the 6-foot lengths could be handled. The City Council accepted this suggestion, and during the

TRANSPORTING THE PIPE TO POSITION ON THE ICE

TIGHTENING THE BOLTS TO MAKE A WATER-TIGHT JOINT IN THE PIPE BEFORE DROPPING IT THROUGH NARROW TRENCH TO LAKE BOTTOM

fall the pipe was purchased and stored on the shore in the most convenient manner for its transport on the ice.

Daily observations of the thickness of the ice were taken, from the beginning of the cold weather in the middle of December, and on Tuesday, December 19, the superintendent reported that the job could be started. The ice was then 10 inches thick, and the temperature 13 degrees below zero in the early morning. The day was used in such preparations as cutting a channel in the ice, raising the old intake, and making a 30-foot skid of 4- by 6-inch lumber for the support of the pipe.

Wednesday morning the temperature was 4 degrees above zero, and at about 11 o'clock in the morning preparations were finished. A ring of ½-inch iron 2 inches wide was bolted to the end of the old intake for calking the bell special which was to be used for making the only lead joint on the job. Shortly after eleven o'clock the first length of new pipe was laid, and from then on the work progressed with surprising speed.

Thursday morning the weather turned warm, and at noon it was above freezing. In the afternoon the ice at the channel was covered with several inches of water and was cracking under the weight of the heavy pipe. In spite of these difficulties there was only a few hours' work left for Friday.

At about 10 o'clock Friday morning the new end of the intake was lowered in 8 feet of water, and the job was finished. The weather was constantly getting warmer, and it is doubtful if any work could have been done in the afternoon.

The laying of the 504 feet of 12-inch cast iron pipe, weighing 80½ pounds per foot, under 5 to 8 feet of water in less than 2 days justifies, I believe, the choice of the pipe and the working method and speaks highly for the ability of the men who did the work.

A Dlugosch is Chairman of the Storm Lake Water Committee, with J. E. Spooner and R. B. Eno, the other two members. The writer was engineer for the Committee, B. Stull, Superintendent of Construction, and O. L. Lezotte represented the Central Foundry Company of New York during construction.

FINAL ESTIMATE OF COST OF THE EXTENSION OF THE STORM LAKE WATER-WORKS INTAKE, DECEMBER 19 TO 22, 1922

504 linear feet of pipe at $2.50	$1,260.00
Specials	46.30
Drayage	28.75
Labor	42.35
Skid	15.05
Engineering, superintendence and incidentals	62.65
	$1,455.10
Less discount for cash	26.12
Total	$1,428.98

$1,428.98 ÷ 504 = $2.84 per linear ft. of pipe in place.

MOVING DERRICK FORWARD TO HANDLE NEW SECTION OF PIPE

Continuous Lettings for Public Works

The Advantages of Continuity and the Savings It Would Effect

A DISCUSSION of continuous lettings naturally falls into three headings: First, would continuous letting be an economy, and an advantage to the contractor and the owner? Second, would it be practical for the owner to hold continuous lettings? Third, if continuous lettings are desirable and practical, what can general contractors do to promote them?

Economy and Advantage

Continuous lettings would mean that engineers and architects would have more time to prepare plans and specifications. They would have more continuous work for their men and would need a smaller force of men instead of putting on a large force for a short time, so as to prepare their work for early lettings, as they have to do now. It would therefore mean plans and specifications prepared more economically. Take, as example, highway work in Minnesota. The first of the year there was no program, but by the middle of March the State Legislature made an appropriation for highway work for the coming year. Immediately every available engineer was put to work, some night and day, in order that the plans and specifications might be prepared in the shortest possible time. From three to seven weeks after the action by the Legislature, there is a continuous round of lettings. Bids are taken on 20 to 40 jobs in one day, and in three or four days more bids are taken. The natural result is that even with night and day estimating and investigation, contractors do not find time to properly figure the work they want. The aggregate-producing plants then start up, but within a short time all their supply for the year is sold, and within a few months there is a shortage of cars.

The Scheme of Continuous Lettings

Continuous lettings would be the practise of letting bids fairly well throughout the year, instead of the present method of attempting to take bids and let most of the work during the first three or four months of each year. The subject of continuous lettings in public and railroad work was discussed in an interesting manner by A. F. Johnson, of Johnson, Drake and Piper, Minneapolis, Minn., before the combined sessions of the Railroad and Public Works Division of the Associated General Contractors at their annual meeting.

Continuous lettings does not necessarily mean continuous construction work, except in parts of the country where climate permits of continuous work throughout all seasons of the year. Where this is possible, it is evident that it would be of decided advantage to both contractors and owners. Equipment would be made to serve more nearly continuously, and hence less equipment would be needed. Contractors would be able to build up a better and more efficient organization, employees would become more skilled and be better satisfied, and work would be done more economically. This would make contracting more of a science of manufacturing. The contractor would have less worry and surer profits, and the owner would receive cheaper and better work.

When construction work cannot be carried on during the entire year, much would be gained by making construction more nearly continuous during the working season, for the same reasons as for continuous work throughout all seasons. By continuous lettings, the various departments of a contractors' organization would become more efficient. At present there is a superabundance of estimating within a short time, with the remainder of the organization marking time. This is followed by very little estimating through the rest of year, and rush orders for the needed equipment and materials, with a grand rush for laborers so as to get the work completed,

Continuous lettings would mean that a contractor would have more time to organize, and most of all, to get the materials necessary for construction manufactured and ready for delivery ahead of time. This would mean economy in the manufacturing of materials and better supply. A great advantage would be the possibility of getting such material delivered ahead of time at the place where it would be needed for construction. This would be a tremendous advantage in paving work, especially where the amount of material to be delivered is great. Nothing else would so benefit the car shortage and freight situation, in general, as such a practise of storing material during the dull season, with a consequent let-up of such shipments during the movement of grain and coal.

To build up a practise of continuous lettings, it would be necessary for the owners to plan their construction programs ahead of time. If the contractors knew the extent of work to be done, they would plan their work to better advantage and prosecute it more economically to themselves and the owner.

Advantages to Owners

The present practise of the railroads is that the Board of Directors in the Annual Budget decides on the amount and nature of construc-

tion for the year. Bids could at once be taken on the most pressing work, and the rest could be let later on in the year. Within a short time, however, the railroads will have to do a tremendous amount of construction work, extending over several years, in order to bring them up to normal. If they then would make a budget of construction covering several years, the work would be planned to better advantage, and a practise of continuous lettings would follow.

Highway work, from the standpoint of service and economy, should be planned over a period of years also, and this work could then be taken care of in like manner. For example, suppose a state should appropriate $50,000,000 for highway work to be extended over a period of five years. The highway commissioner would naturally plan to expend about $10,000,000 each year. He could then, to the advantage of his own department, plan to let, say, $3,000,000 worth of this work in the fall, $3,000,000 worth of work during the winter, $2,000,000 worth of work during the spring, and the rest during the summer months. Even with a one-year program of highway work, some of this work should be let as early as possible and the remainder spread more over the rest of the year.

This will apply in like manner to public works of all kinds. In many cases, however, it would be harder, because of politics, to make plans for work over an extended period, especially in municipal work.

How General Contractors Can Promote Continuous Lettings

Associations of general contractors could take this subject up with the proper officials of the United States Government and with the Congressional Committee which has charge of construction appropriations of various kinds. The advantages and economies from continuous lettings should be demonstrated to them. General contractors should also advocate, and advertise wherever they have an opportunity, the advantages of such a practise to those with whom they have business dealings.

The Day Labor Fallacy

A GREAT many newly elected public officials have recently taken their places on county boards and are serving in various other public capacities. These men are naturally anxious to make excellent records for themselves, both by getting desirable things accomplished for their constituents, and by effecting economies wherever practicable. About the first thought that comes to mind in looking over the field for possible economies is the possibility of cutting out the contractors' profits.

Educational work, bringing to light the truth about the relative merits of the contract and the day work systems of doing public work, would seem to be desirable, not only among the general public, but among those public officials who have not had practical experience in construction.

The day work plan looks attractive. "Why not save the contractor's profit to the taxpayers of the county or the city?" asks the official. The fact is that in answering that question many officials fall into the common error of forgetting that the contractor's profit is, in effect, a fee, paid him for his knowledge and his experience, which enables him to carry out the plans of the engineers or the architects economically and effectively. And it is a fact that any one who has had occasion to analyze the bids submitted during the last year on public work, is quite ready to acknowledge that seldom have contractors received profits that by the most critical could have been termed excessive. Under the keen competition which has prevailed, the opposite has been generally true.

The contractor has the biggest possible incentive to use the greatest care in buying materials and in seeing that his employees do a fair day's work. The contractor knows that the size of his profit will be largely determined by his ability to buy in the best market, and by the skill and energy of the individuals comprising his organization. Contractors have sometimes traced losses directly to the fact that their employees have not put the requisite amount of energy into the work. The man employed by a county or a city to supervise construction under the day work plan has no such incentive to keep an organization at a high point of efficiency. If the men do a little less work on the job, the only one who loses is the taxpayer. Incompetents and laggards stand a better chance of being retained on the public pay-roll than they do of being kept on the pay-roll of a contractor.

Of course, it is possible to find here and there instances in which public work has been carried forward effectively and economically under the day work system. It will be found in every such case that the public official who is at the head of the work has the forceful qualities of the successful executive. But even men having such ability are so often hampered by red tape that their work is ineffective. At best, they fulfill the duties of the contractor without having his independence of action, and their salary must be balanced against the profit the contractor would receive.

When the cost of public construction by the day work system is compared with the cost of similar work carried forward under contract, it is often found that any apparent advantage possessed by the former melts away when the overhead is properly figured. The day work system is not immune from those overhead charges which must commonly be carried by the contractor. In fact, the prevalence of red tape in public business often makes the overhead higher under the day work plan.—*The Improvement Bulletin.*

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Partnership Not Bound by One Member's Guaranty

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Under these circumstances, it was held by the Texas Court of Civil Appeals in the case of Foust vs. Smith & Helms et al., 246 Southwestern Reporter, 106, that the firm was not liable. The decision proceeds under the fundamental rule of law that one partner is not entitled to bind his firm by undertakings not within the fair scope of the firm business, without the assent of his associates. A standard legal authority, summarizing numerous court decisions, has said:

"The normal partnership is organized to carry on a business for its members, and not to assist other persons by becoming surety for them, or answerable for their debts. Hence it is well established that a partner has no implied authority to bind the firm by a contract of guaranty or suretyship. One who would hold the firm on such a contract must show that it was within the common course of business of the firm or within the previous course of dealing between the parties, that it was actually authorized by the firm, or that it has been ratified by the other partners." 30 Cyc. 515.

Building Inspectors Not Omnipotent to Refuse Permits

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Oral Contradictions of Written Construction Contracts

There is a general rule of law, subject to certain exceptions, that neither party to a written contract will be permitted, over objection of the other, to set up a claimed verbal understanding, antedating or contemporaneous with the execution of the written contract, and at variance with the terms of that contract. The principal exceptions to the rule cover cases of mutual mistake, fraud of one of the parties, and matters on which the written contract is silent or ambiguous.

The rule was invoked before the West Virginia Supreme Court of Appeals in the late case of Corns-Thomas Engineering & Construction Co. vs. McDowell County Court, 115 Southeastern Reporter, 462. The Court affirmed judgment in favor of plaintiff on a claim for compensation for constructing concrete abutments and wing walls for a bridge.

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The rule was invoked before the West Virginia Supreme Court of Appeals in the late case of Corns-Thomas Engineering & Construction Co. vs. McDowell County Court, 115 Southeastern Reporter, 462. The Court affirmed judgment in favor of plaintiff on a claim for compensation for constructing concrete abutments and wing walls for a bridge.

It was decided that because the working plans

were silent as to the depth of excavations to be made for abutments it was proper to admit oral proof of an agreement as to the depth. But it was held that if there was a plan in existence when the contract was made, referred to by the contract and showing the depth intended, the agreement as to depth thereby formed could not be contradicted by one party showing a contrary verbal understanding.

The opinion, however, fully recognizes the right of a contractor who has been induced to enter into a contract through mutual mistake, or through mistake on his part and fraud on the part of the other party to the contract, to show the falsity of statements made by the latter, as a basis for avoiding the contract.

What Constitutes "Portland Cement"?

A contractor ordered a quantity of "portland cement," informing the selling dealer that the material was desired for use in constructing hard-surfaced concrete floors. No particular brand was bargained for, the contractor expecting that one of six or seven standard brands would be delivered. The cement delivered was one of these brands, but proved to be so inferior in quality that it would not produce solid, smooth, hard and glazed floors. The floors checked and disintegrated. In litigation between the parties, the Kansas Supreme Court has decided that there was an implied warranty that the cement delivered would be suited to the intended use. (Burgner-Bowman Lumber Co. vs. McCord-Kisler Mercantile Co., 212 Pacific Reporter, 108.)

The Court distinguished a decision of a New Jersey court, where it was decided that where cement was sold by brand, without contemplation as to its particular use, the seller was not bound by any implied warranty of quality. All that he was bound to do was to deliver material conforming to the standard of the brand specified. (50 Atlantic Reporter, 355.)

In the course of its opinion, the Kansas Court said of the case before it:

"The article purchased was portland cement; the thing delivered was not portland cement, because it did not possess the well-known qualities and characteristics which portland cement always possesses. Portland cement is a definition, and means a standard, not a brand. In this respect it is like the use of the definition 'sterling silver.' The term is understood in the building trade generally to mean an article which possesses certain qualities. To the contractor in this case it made no difference whether the cement he purchased was made in one town or another. To meet his requirements it had to be portland cement."

No Right to Additional Compensation for Incidental Work

That a contractor must bear the expense of operations incidental to performance of his agreement is shown by the decision of the Ohio Supreme Court in the case of Ashley vs. Henahan, 47 Northeastern Reporter, 573, where it was decided that a contractor was not entitled to an extra allowance on account of shoring up an adjacent building, as a necessary incident to excavating for, and constructing a foundation. The Court observed:

"By reference to the first clause in the contract, it will be seen that it required the contractor, under the direction and to the satisfaction of the architect, to do all the work included in the 'excavating,' 'foundations,' 'stone walls,' etc., agreeably to the drawings and specifications, 'including all labor and materials incident thereto.' He was then to make the excavations and put in the foundations. No provisions were made for any unexpected difficulties in doing the work. He undertook to do it, and was as familiar with the situation as the defendant. The proof showed that without underpinning the house and using the lumber that was used, the excavation could not have been made, nor the foundations constructed. They were, therefore, labor and material incident to the work he had undertaken to perform. . . . In Stuart vs. City of Cambridge, 125 Mass., 102, the plaintiff had undertaken by a written agreement to erect and complete the masonry of a building according to plans and specifications. These showed no requirement for piles, which, on the direction of the architect, were put in by the contractor, and they sued the defendant to recover on account for labor and materials so furnished. Morton, J., said: 'By the fair construction of this contract, the plaintiffs agreed to do all the work necessary to secure a solid foundation. They took the risk of its being necessary to drive piles in order to secure such foundation.'"

Waiver of Rights Under Contract

Where a cement company contracted to sell and deliver a stated quantity of cement, with option to refuse to deliver after a certain date, and the buyer later requested that daily deliveries be reduced to a certain per diem quantity, which did not enable delivery of the aggregate contract quantity before that date, the seller did not necessarily waive the option to make deliveries after that date. Whether or not there was a waiver was a question of fact to be determined under all the circumstances bearing on the mutual intent. This is the substance of the principal conclusion reached by the New York Court of Appeals in the case of Lord Construction Co. vs. Edison Portland Cement Co., 138 Northeastern Reporter, 39. The Court remarked:

"Did defendant's silence indicate an intention to relinquish its right to withhold delivery, inconsistent with the position afterwards assumed by it?

"'No duty to speak arises from the mere fact that a man is aware that another may take an action prejudicial to himself if the real facts are not disclosed.'

"Mere silence on defendant's part is not enough to fix its liability. It must be 'a deceptive silence, accompanied by an intention to defraud, which amounts to a positive beguilement.'"

Control of the Use and Waste of Water by Contractors

The Opinions and Comments of Some Water-Works Engineers of Indiana

Experiences of the Water Utilities in Newcastle, Ind.

By W. L. Younce

Superintendent of Water-Works, Newcastle, Ind.

NINE years ago there was no system by which contractors were checked up when they used water for any purpose, nor was any attention paid to the breakage of city property or its misuse by contractors. It was necessary to straighten out the matter in a way which would be satisfactory to the city, so considerable activity was instituted in which some contractors were brought up before the Mayor on charges. The Mayor gave them a fatherly talk and told them he did not want to have them appear again before him on the same complaint. This had the desired effect; the contractors generally saw the justice of the argument and there was no further trouble for some time.

Advertisements have been inserted in the newspapers calling the attention of all consumers to the fact that they are responsible for the use of water. The trouble experienced in Newcastle has run from the misuse of water by contractors to the breaking off of service boxes and valve boxes, and in many cases to covering them up or paving them over, necessitating digging up the street and repairing it after raising the box. Many times contractors have unfortunately paid no attention to making arrangements for the use of water. Most of them have hydrant wrenches and reducers for connecting hose to the fire hydrant, and use water when they please. When this has been discovered by the Department, the custom has been to charge excessive rates, which has had a tendency to make the contractor come in and make some arrangements before using water.

The City Engineer notifies the Water Department when a contractor is doing work, thus enabling the Department to make investigations and to bill the proper charge if the contractor has apparently forgotten his duty.

At the present time there is no trouble in Newcastle through the misuse of water. The contractor comes in, makes arrangements for using the water, is furnished with a meter, which he attaches to a residence faucet connection, and uses the water from this. If he uses the water from a place that is already metered, he settles with the property owner. If he wishes a greater quantity of water than flows through a house service, he is furnished with a connection for a fire hydrant, to which a meter is attached. There has never been any trouble from hydrants leaking from this cause.

The contractor is expected to disconnect the meter connection if there is an alarm of fire in the immediate neighborhood, so that the fire company can use the hydrant. He also disconnects the meter connection each evening and at the noon hour. There has been no trouble in collecting damages for breakage.

Are You a Sinner in the Eyes of the Water Utility?

Water-works superintendents and officials of some Indiana cities seem to think that contractors have been careless in the use of water, but that they mean well. Where the cooperation of the contractor has been sought, there has been little difficulty, but when he is looked upon as a criminal sinner who wastes water with malice aforethought,—well, he is only human and there is naturally an antagonistic reaction. If love makes the world go round, then cooperation will make the meter registers whirl and there will be little difficulty from thoughtless or wanton wasters.

Members of the construction industry—not the fly-by-night builder who may have been a shyster lawyer or a broker a week ago—are responsible individuals. A spirit of pride in their work, a sense of duty, pervades the entire industry. The responsible contractor will not intentionally waste that necessary commodity which, when purchased at the regular domestic meter rates, is the cheapest material he uses, whether figured by the ton or by the cubic yard.

Perhaps someone who has been careless will appreciate the difficulties experienced by the water utilities after reading this article and may have a plan to offer to the next water official he meets that will demonstrate his desire to maintain the integrity of the construction industry through cooperation and economy.

Experiences in Gary, Ind.

By William Luscombe

Vice-President, Gary Heat, Light and Water Company, Gary, Ind.

IN some places where it is practicable to furnish water to contractors by meter measurement, the problem is quite simple, and it is undoubtedly the most just and equitable way to sell water. However, local conditions in some cities and towns make the meter plan of furnishing water to contractors quite expensive to adopt successfully. In Gary the flat rate plan of assessment is used.

The percentage of water sold to contractors by our company during the building season months, if figured at regular meter rates, ranges only from 3 to 8 per cent of the total. In the great majority of cases, water is furnished to them on a flat-rate basis, and during the summer months when work is carried on throughout the city, the water wasted by them has been found to be relatively large. By investigation, we believe the waste sometimes greatly exceeds all legitimate use.

In an average case the contractor first makes application and pays for water to be furnished for certain specific purposes, the charge being figured from the blue-prints which he submits to the company. A few days after the application and the taps are made, the inspector visits the premises and notes the uses and abuses, if any, and frequent inspections are continued during the progress of the work. In checking up, in the field, the uses, quantities, etc., applied and paid for, it is a common thing to find that water is being used for purposes not authorized or for uses in excess of quantities applied for. The greatest trouble, however, is with the comparatively great waste.

In Gary, most of the mains are laid in the alleys, and the water company taps the mains and installs the service pipe to the property line at its own expense. At the rear property line the contractor has a temporary riser pipe and connection installed for use during construction, and from 75 to 100 lineal feet of ¾-inch hose is used to conduct the water from this riser pipe to the place where it is wanted. It is a very common occurrence for the inspector to find a full flow of water being discharged and wasted through the hose. Usually the contractor is absent, and when the foremen or workmen are asked why they waste the water, they simply reply that someone forgot to turn it off, or that it makes better and cooler drinking water to allow it to run, or that it is too inconvenient and takes too much time to reach the faucet or valve on the riser pipe so often.

The sand, on which practically all of Gary, Ind., is built, makes an excellent sieve for the wasted water to pour through without annoying or inconveniencing the workmen or any other party, and it is very difficult at times to detect waste, because only a small spot on the surface, perhaps not more than 6 or 8 feet in diameter, is flooded. If the workmen see the inspector first, no waste is found, but as soon as he leaves, the evil may continue without detection. Under the pressure carried in the mains, water discharged through 75 feet of ¾-inch hose, flowing only one-half the time of the working hours during the construction period of an ordinary dwelling, say about 90 days, will amount to about $30 by meter and a monthly rate of 25 cents per 1,000 gallons for the first 20,000 gallons, and 10 cents per 1,000 gallons for the excess. In furnishing water for building purposes in the construction of such a structure, the company usually receives about $3.50, so it is very plain that no inspection charges or abuse of the privilege is provided for in the cost, and where considerable waste is practised, this service is furnished at a loss to the company and has benefited no one.

If a contractor's men are found wasting water, they are cautioned in a friendly but firm way, and for the third offense the supply is discontinued and the company refuses to turn it on again until assurance is given that the privilege will be used and not abused; the contractor pays $1 for renewing the service. Unfortunately, it is occasionally necessary for a violator to have this experience two or three times before he realizes that waste cannot be tolerated by the company. It has been decided that in cases of repeated and flagrant violations, instead of discontinuing the supply for just cause, the company will in addition require the offender to provide a suitable place for a meter where it will be accessible for reading and repair at all reasonable times, and then furnish him water only at the regular meter rates. The question of why this is not done in the first place, might well be raised. The answer is, that because of local conditions and the methods used in installing the water service and sewer pipes from the rear property line into the premises, the plan is a rather costly one and not altogether satisfactory. It would cost between $14 and $18 to provide a satisfactory place for a meter to be put in a temporary vault located near the alley line, and the company is opposed to placing this burden on a consumer if it can reasonably be avoided. Also, meters are sometimes found covered or broken by building materials, rubbish, etc., or filled with sand, or the meter is damaged, changed to an improper position so it does not register accurately, or disconnected. It will thus be observed that it is not an ideal solution of the problem, and if special care and interest are taken, it is believed that these troubles can be minimized and water waste materially checked.

It has been suggested that, inasmuch as Gary, Ind., is about 100 per cent metered for permanent use, and as all meters are inside settings, usually in basements, it would be best to have the permanent service pipe installed from the alley line into the premises at the beginning of building operations. The objection to this is that the sewer pipe and an extra strong lead water service pipe are laid in one wide trench, the water pipe being above and to one side of the sewer pipe, and as the contract for the trench work in which to install these pipes invariably is not let until after the building construction is well under way, a temporary water

connection and riser near the rear property line is installed for immediate use.

While most of the cases arising from contracting operations are those pertaining to the use made of water in the construction of dwellings, apartments, stores, etc., numerous demands are also made to furnish water for the improvement of streets, alleys and cement walks and for miscellaneous uses where water is wanted to be drawn from public fire hydrants.

The position has always been taken that public fire hydrants should be used exclusively for fire purposes, as they are not designed or intended for other use. The company is very proud of the service it has given to the city and its citizens in extinguishing fires since the water system was first installed, about 16 years ago. The success of these services is due largely to the fact that all public fire hydrants are maintained in good condition and the promiscuous use of them is forbidden. Immediately after any of them are used, they are inspected, so that it is known that they are left in proper condition. When the only available means for obtaining water for special purposes is the fire hydrants, their use is allowed. A permit is issued by the company, but revokable at its pleasure, providing that the applicant first obtains written permission from the Chief of the Fire Department for the privilege and delivers the permit to the company. Daily inspection is made of the hydrants used in the built-up portion of the city, and frequent inspections are made of others so used. Permission is not granted to use hydrants for such purposes during the winter months. Contractors very seldom use hydrants without authority, as there is a city ordinance penalizing such action. When permission is given to use hydrants, a spare nozzle cap is usually converted into use as a reducer, and with the use of a nipple and valve connected to the reducer, the small valve is then operated by the contractor. This obviates the necessity of the frequent operation of the hydrant main valve. When a continued use is desired from any particular fire hydrant and it is practicable to do so, water is furnished by meter. In many instances, however, the uses are of such a temporary nature that a flat rate is charged, and in such cases frequent inspections are made to watch out for abuses, for immense waste can occur by neglect in a very short time through such large openings.

I firmly advocate furnishing water by meter to contractors wherever it is practicable to do so and the meter can be set at a nominal cost, as this is the fairest way to determine and assess the just charges for the commodity supplied. In the majority of cases it will result in lower water bills, because the contractor will then make it his business to see that waste is practically eliminated, and he will profit accordingly. The utility could economize and dispense with the frequent visits to the job which are necessary under the flat rate plan. These visits are always offensive to the contractor and irksome to the inspector, because of the disagreeable notices he may be obliged to serve in order to curb waste. Selling water by meter will produce far more friendly relations between the utility and the contractor.

Not Much Trouble in Terre Haute

By Dow R. Gwinn

President and Manager, Terre Haute Water Works Company, Terre Haute, Ind.

THERE are all kinds of contractors, but we do not have much trouble with them.

At one time we had lots of faith in human nature and we gave them a card and told them, "This gives you the right to use water, and you can come in at the end of the season and tell us how much you used." Unfortunately, we lost part of our faith in human nature.

Now we put a meter on the service pipe, and the owner of the property is charged with the water, so that he has to look after the contractor. When it is a large building and requires more than ordinary service, a 1-inch meter is installed and $36 is deposited. The balance is returned to the owner after all the bills are paid. Sometimes a 1¼-inch tap is installed for street paving work and taken out when the work is finished. A deposit must be made, on the basis of the size of the meter. If it is a 2-inch meter, a deposit of $75 is required. On the small house, when you put in a meter when the house is started, and charge the water to the owner of the property, you get rid of a lot of trouble which you would ordinarily have with contractors.

No Trouble with Regular Contractors

By J. O. Endis, Jr.

New Albany Water-Works, New Albany, Ind.

IN the last few years there has been considerable construction work in New Albany, and during that time new contractors have sprung up, some legitimate and others not. There has been no trouble in collecting from men regularly engaged in the business, and they do not waste water, but it has been difficult to collect from out-of-town contractors. We issue a yearly permit for the use of water by contractors, and at the end of the period they bring in their yardage as to the amount of concrete they have used, the number of brick laid, etc., and are charged accordingly. We have not been able to measure contractors' services by meter, because until the last two years there have not been many meters in New Albany. Up to two years ago there were 400, and since that time 1,000 have been installed.

Regular contractors in business in New Albany cause no trouble. It is the new men who come into the city and take privileges to which they have no right that cause most of the trouble. They come in without any notice to the company, and unless inspectors are sent around, their use of water is a dead loss to the company. A contractor recently came from another city to do some construction

work and made use of a fire hydrant which is operated by the company at its own expense. Unfortunately, it is hard to make the contractor see that the company is entitled to some return for the use of the hydrant and its services.

A series of letters has been prepared, addressed to the contractors in the city, asking for their cooperation. The general contractors who are regularly engaged in business and who pay for the services they receive, complain of the contractors who come from outside of the city and do not pay for water and who bid against them and take away their jobs because of this saving. Recently, a meeting was held in the company's office to which all the general contractors were invited. They have gone on record as desiring to help the company and are reporting contractors who are wasting water or who are not paying for the services.

It takes practically all of the time of one man, traveling around continually, to keep track of the irregular contractors. It is hoped that the present campaign to secure the cooperation of all contractors will materially reduce the unpaid-for use of water and eliminate waste.

Special Services for Contractors in Ft. Wayne, Ind.

IN Fort Wayne, contracts on alleys, sidewalks and streets are taken care of by putting in contractors' services. The City Engineer furnishes us with a yardage, for which a charge of ¼-cent per yard is made to the contractor for water service. All the small dwelling-houses in the city are metered, and if there is no service available where a man is building, he usually makes arrangements with the next-door neighbor to buy water from him. In the case of a big building, if a man cannot get water, he is out of luck. No one is permitted to tap hydrants, except the water department, the fire department and the street cleaning department, and the last-named will probably soon be eliminated from the list and be required to install service taps.

If a small contractor does not pay for the water used, the water is not turned on again until it is paid for, and in such case the owner of the building under construction usually makes it hot for the contractor so that the water service may be secured.

Miscellaneous Notes

Service Motors, Inc.

ANNOUNCEMENT has been made that Service Motors, Inc., a Delaware corporation, has taken over the business of the Service Motor Truck Company, Wabash, Ind., and will continue to build Service motor trucks and Service railroad motor coaches. The new firm has assets in excess of a million dollars. This is a result of the reorganization plans started last November for the Service Motor Truck Company, and assures adequate capital to meet all needs for manufacture and further expansion.

Paul Moore, who is the President of the new company, has been with the Service Motor Truck Company for eight years and is thoroughly familiar with all the details involved in the manufacture and distribution of trucks. He has had charge at various times of sales, advertising and production departments of the Service trucks.

Expanding Heil Service

THE Chicago offices of the Heil Company, of Milwaukee, Wis., have been moved from their former location, 2718 Wentworth Avenue, to 2422-26 Cottage Grove Avenue. The new service and sales rooms of the Chicago distributors have three times as much floor space as the old offices. Twenty men are employed in this service station to mount Heil hoists, body, and tank equipment. According to H. F. Kneppreth, Manager of the Chicago branch, there is a considerable demand for this truck equipment and hydro-hoists in Chicago. A daily truck service has been established from the Heil factory in Milwaukee to Chicago, enabling customers to get practically immediate delivery of their orders.

The New York distributing station of the Heil Company, the Motive Parts Corporation, has moved from 136 West 55th Street to new offices at 796 Tenth Avenue, near 53rd Street, New York City.

The H. P. Wilson Company, of Denver, Colo., have recently become Heil distributors for that district. The offices of the Wilson Company are located at 17th and Blake Streets, Denver, Colo.

Summer Courses at Carnegie Institute

COURSES of interest to nearly everyone in the technical fields are to be given this summer at the Carnegie Institute of Technology, Pittsburgh, Pa. The courses open June 25 and continue for 8 weeks—until August 17. Six-week courses will be conducted from July 2 to August 10. Of special interest to readers of CONTRACTORS' & ENGINEERS' MONTHLY is the wide range in engineering subjects covered by theoretical instruction in shop practise. The college of engineering will give courses in drawing and descriptive geometry, chemistry, physics, mechanics, surveying and coal mining. In the College of Industries there will be chemistry, drawing and geometry, foundry and machine shop practise, architectural drawing, electrical equipment and installation, plumbing, heating and ventilating, welding, sheet metal work, wood working and cabinet making, and manual arts education.

The Value of a Central Estimating Bureau

With Particular Reference to the Building Industry

By G. Szmak

Managing Engineer, Universal Acme Engineering, Bridgeport, Conn.

THE major purpose of a central estimating bureau is to provide a systematic and equalized method for competitive bidding, by classifying openly and in the simplest way the real value of materials and labor as compared with the price. The need of bureaus conducted on these principles is obvious to anyone in the building industry. Criticisms of certain practises which have been carried on in the building industry make the use of such a bureau practically imperative, as it permits public inquiry at all times. No fair-minded person would look on in toleration at a competitive foot race where the contestants did not start off on an equalized basis, and even less would he care to enter it; yet such are the conditions in the building industry under the system in use for competitive bids. The evils of this system are reaped by everyone, just as the benefits of a definite quantity survey will be gained by everyone.

It is true that the ability of any contractor or builder to perform work of any type or character with his organization and plant is very different from that of every other contractor or builder, but these inequalities may be overcome by careful selection, and the owners' opinion may be gaged by the past performance of the contractor.

The greatest evil in construction lies in the uncertainty of the methods used by contractors in submitting their respective bids, for there are as many lists of quantities and labor costs as there are bidders, and material costs are priced from as many quotations as are procurable by each particular contractor, regardless of specific quantities or qualities. The result is a mass of figures ranging from 1 to 35 per cent under or over the normal cost. Can this truly be called fair competition?

The compilation of productive data prepared accurately and simply and assuming full responsibility for the work, which would require no further duplication of effort after it had been done, would indeed be a valuable service and greatly eliminate worry and waste. It is within the scope of central estimating bureaus to give such service if given ample cooperation, time for preparation and the requisite fundamental information about plans and specifications. It is possible to classify and summarize only such works as are given in detail, which are measurable in quantity, described in quality and made clear as to conditions. These factors are characteristic of nearly every kind, class or type of work upon which organizations may bid. The few occurring uncertain conditions that cannot be contracted at predetermined costs should ethically be numerized and recorded for the consideration of the owner and the contractor.

An Impartial Economic Service

A central estimating bureau furnishes an impartial, economic service prepared in cooperation with the owner, architect or engineer, contractor or builder, the manufacturer of building materials and his dealer. Without any direct individual commercial interest in the various units of the industry, it can best serve to benefit the entire group, without restraint. The work of a central estimating bureau, best exemplified in its quantity surveys, saves the time of the architect or engineer, provides a check which is invaluable to the owner, and prevents duplication of effort in contractors' estimates, from which bids are prepared.

Other Services Available

The contact of the central estimating bureau with every unit of the building industry enables it to gather a vast amount of information and to distribute it in the form of leaflets and bulletins among the industry and so greatly promote the commercial and ethical development of the profession and trade. Information created in the preparation of the bureau's services, such as material and labor costs, current estimated square- and cubic-foot unit building costs, forms valuable statistics and should be generally accessible to the industry and its clientele. In this way bureaus can help to gain public confidence and stimulate business.

Contractors are always anxious to know the results of their bidding and are certainly entitled to a complete record showing the individual standing of each bidder, and thereby gain information which may be of future use. Without any definite office interested in the compilation of these facts, it nearly always happens that the contractor does not even receive thanks for the trouble and expense of estimating.

Sometimes contractors question whether they are receiving a fair deal from the owner, architect or engineer in spite of competitive bidding. This question can be overcome with absolute fairness through submitting sealed

copies of their bids to the bureau whenever tendering a proposal. After the award is made, the figures of the competitive bids are openly passed to each bidder. In this way each receives positive insurance against unfair consideration.

Listings of materials with quantities are often required in the field and office for the purpose of ordering, but there is not the time necessary or competent help available to secure the information wanted. Bureaus engaged for this work are dependable and very convenient, and also save in costs.

Engineers and architects frequently place building supervisors on jobs calling for their services, but very often most of the supervisor's time is taken up in checking contractors' invoices, leaving very little time for actual building supervision. The job of thoroughly checking contractors' invoices of materials and labor is not part-time work. It requires expert knowledge of construction field accounting. Not only is this service valuable to owners, architects and engineers, but it is also to the advantage of contractors to employ bureaus offering such service, as they are more willing to assume greater responsibilities for the accuracy of the quantity surveys and in general for all their work, because they are continually in practical contact with field activities.

Those contractors desiring to increase their operating territories before submitting bids must make inquiries at the immediate locality of the proposed work, to determine the exact existing conditions locally as regards labor, materials, site of operation, transportation, etc. The central bureau is better fitted to make this report to the bidder, as it has in its possession, fully classified, most of this information, or if not, it can readily secure the exact information required at a minimum of expense.

Practically 85 per cent of the effort and expense of estimating by contractors or subcontractors is absolute waste. In the case of the general contractor and the client, the latter likes to have a check upon the bids received. Central bureaus can give this service in positive confidence and with greater accuracy than by any amount of wasteful multiplication in the number of bidders and bids received. Under the prevailing methods for bidding, it would not make a particle of difference if nine bids out of ten were exactly alike, which is almost impossible with unlike quantities; the tenth bidder, who through inaccuracy of quantities submitted a lower bid and was financially responsible, would be awarded the contract, even though the bids were used to check against each other. Quantity surveys prevent this.

The general contractor as a rule does not figure every portion of the contract, but requests subcontractors to submit quotations on various kinds of work. In the majority of cases this is not done to secure better bids in competition, but because it enables the general contractor to get a figure on that portion of the work—and they usually get several, many with very uncertain provisions and radical costs. It is within the scope of the central estimating bureau to provide these sub-bids without wasting the duplication to the industry at large, and, further, such a bureau is in a position to secure responsible sub-bids for specialized work.

Contractors, engineers and architects are burdened with a great many tentative and speculative projects, which, if referred to a central bureau, would result in a large saving of time and money to everyone concerned. A clientele desiring information for an active program would be likewise benefited. Construction appraisals needed by owners, realtors and bankers, unless reestimated with definitely known material and labor rates, compiled from past and current values, are mere approximations. Rate records are always at the disposal of the clients of well-established bureaus.

Fundamental Benefits

The advantage of using a definite quantity survey of materials, and its labor applications are too numerous for mention within the confines of this article, but many are well recognized by most members of the building industry. Some of the results are better business, more skillful workmanship, the elimination of waste, efficient cooperation, fair costs and fair profits. All of these are obtained simply because the contractor or builder receives definite knowledge of the items of materials and labor for which he may be held responsible, before he assumes any obligations on the contract.

There is no need to gamble on work that may look good or bad at the start and that may turn out to be a bonanza or a failure at the finish. The contractor does not have to skimp on workmanship or quality of materials in order to build up profits which have been taken by unforeseen or omitted items, many times not entirely through his own fault. The elimination of uncertainty is sure to result in less duplication and waste. Efficient cooperation is always present where there is no need for selfish motives. Fair costs and profits can result only when estimates are compiled on like quantities, and all the bidders are thus placed on an equal plane. The current costs of materials, labor and profit contingencies do not permit much variation, and with a quantity survey bidding would become stabilized to such an extent as to command public respect and trust. The cost of preparing any individual survey is no greater than would have to be paid for a reliable estimate by each user, and in consideration of the advantages and merits of the central estimating bureau, the cost is negligible.

Summary

The owner ultimately saves a large sum which would have been spent in multiplied efforts used in wasteful estimating by contractors, builders, manufacturers and dealers in construction materials. In addition, there is a distinctive advantage in open dealing through equalized competition.

The engineer or architect is provided with an absolute check upon his plans and specifications before the contract is awarded, thereby avoiding endless trouble and inconvenient pro-

ceedings during construction. Reliable cost data are always at their disposal, which is necessary in the efficient designing of new projects. The lack of this information very often results in redesign or in loss of a client.

The contractor, builder and subcontractor are relieved of cumbersome work in preparing quantity surveys and estimates, at least 85 per cent of which heretofore has been unfruitful effort.

The manufacturer and dealer, through the established use of specific qualities and quantities, will be able to develop new and productive territory with minimum effort and expense.

TYPICAL FORM OF SURVEY

Type of Building (41) Apartments—Cubic Feet 560,000—Unit
Location, Bridgeport, Conn.—Square Feet 57,000—Unit
Owner, A. L. Yarbrough—Comm. No.—Date
Architect, E. B. Caldwell, Jr.—Survey No.—Approved by

SUMMARY

(1) General Conditions
(2) Earth Work
(3) Stone Foundations
Concrete and Cement Work
Brick Masonry
Artificial Stone Work
Structural Terra Cotta Tile Work
Structural Gypsum Tile Work
Damproofing
Structural Steel
Pressed Steel Floor Construction
Steel Stair Construction
Ornamental and Miscellaneous Metal Work
Sheet Metal Work
Roofing and Flashing
Furring and Lathing Work
Plastering Work
Door Construction
Window Construction
Interior Tile Work
Interior Marble
Interior Wood Flooring
Cork Composition Work
Carpentry Work
Interior and Exterior Woodwork
Hardware
Painting Work (including general conditions)
Plumbing and Gas Fitting (including general conditions)
Heating Work (including general conditions)
Electric Wiring (including general conditions)
Light Fixtures
Dumb Waiters
Elevators
Total Material and Labor
Compensation and Liability Insurance
Surety Bond
Contingent and Profit
Amount of Bid

Descriptive—Basement, five stories, one apartment and three elevator pents above main-roof; stone foundations, brick exterior and interior bearing walls, terra cotta furring and partitions, gypsum tile partitions, structural steel framing, pressed steel joist floor construction; hollow metal, metal covered and wood doors; wooden windows, plumbing and gas fitting, heating, electric wiring, dumb waiters and elevators.

A Statement of the Job

Items of Material and Labor Application	Notes	Quantities (net)
(1) GENERAL CONDITIONS		
Snow and ice removal—cleaning walks, etc.	During winter construction	Allowance
Sanitary arrangements—for workmen		Allowance
Radiators set up for temporary heating	By heating contractor	No item
Fuel for temporary heating	By owner	No item
Operation and responsibility (day and night)	By mason contractor	Allowance
Surveyor—lines and levels	By mason contractor	Allowance
Layout and batters		Allowance
Building permit		Allowance
Minor permits and fees—public service, etc.		Allowance
Fire insurance	By owner	No item
Field office for architects' and contractors' use		Allowance
Telephone service		Allowance
Rubbish—cleaning up generally		Allowance
Small tools used up on job		Allowance
Small miscellaneous carting and unloading		Allowance
Cutting and patching for trades generally		Allowance
Housing (damageable) materials from elements		Allowance
Templates, patterns, models and drawings		Allowance
Board covering for protection—where required		Allowance
Plant and equipment—install, remove and depreciation		Allowance
Quantity survey		Price as agreed
(2) EARTH WORK		
Excavation—cellar, areas, trenches, piers, etc.	12 inches outside of fds.	2,500 cubic yards
Removing loam		Allowance
Back fill at foundations		205 cubic yards
Grading basement floor—for base		Allowance
Rock excavation—by blasting per cubic foot	Extra to contract	No item
Stone on site—by blasting or otherwise per cubic foot	If suitable for use	"Credit owner"
Boulders and loose stones—removed	Not extra	Allowance
Surplus excavation—removed from site including loam	If not needed	2,295 cubic yards
Finished grading and loaming	Not in contract	No item
8-inch cinder fill—under cement walk		1,335 square feet
Remove old paving and excavate for new walk		1,335 square feet
8-inch cinder fill—under brick paving		670 square feet
Excavation for all ext. sewer and drain work		300 cubic yards
Back-fill—for all ext. sewer and drain work		300 cubic yards
(3) STONE FOUNDATIONS		
Local stone wall and trench fds.	Pointed 2 sides	10,300 cubic feet
Portland cement mortar for setting of	11,450 cubic feet	Allowance
Dressed random ashlar jointed-grade to water table	Average thickness, 6 inches	2,300 square feet
Cleaning and pointing—face work		2,300 square feet
Unloading—at site	Labor only	1,150 cubic feet
Staging for above works	11,450 cubic feet	Allowance

Elimination of the Irresponsible Bidder

It Can Be Accomplished Through the Education of the Public and Bonding Companies

By W. A. Simpson

W. A. Simpson Construction Company, Los Angeles, Calif.

WE all have a different idea of irresponsibility, and on that word hinges everything—whether we are for or against it. An irresponsible person is one who fails to give satisfaction in one way or another. The degree of irresponsibility depends entirely on the degree of ability to render service or satisfaction. Therefore, many contractors who now pride themselves on being 100 per cent responsible, had better go over every item that constitutes responsibility and see if there is not at least one thing in which they are irresponsible.

What Is a Responsible Contractor?

A responsible contractor is one who offers service, not only in one or two things, but in every possible function comprising the contracting business. What are these important essentials which a responsible contractor must have? A few of them are capital, experience, business training, ability to purchase and hire, good judgment, intelligence, self-control, integrity, faith, organization, equipment, and a sense of justice.

A responsible contractor visualizes a project and then carries his vision into an object of reality. He does not allow the dollar to obscure his vision in producing commendable structures. He must be a medium through which construction work is economically and accurately done and must leave to posterity some name other than a crook. A responsible contractor interprets incomplete plans and specifications in the light of his practical experience and violates no confidence placed in him.

Responsibility must include knowing how to prepare an accurate estimate, taking care of all overhead expenses and contingencies, and being willing to pay for an accurate cost-keeping system so as to better prepare for the next piece of work and also to become acquainted with his own mistakes. A responsible contractor seeks to gain and hold public confidence.

Improving the Irresponsible Contractor

How is it possible to get rid of the irresponsible contractor? My answer is, by education. By that I mean not a broad education in technical sciences, but teaching men to use common-sense fairness in their business. We must educate the contractor who is now irresponsible so that he can become responsible if he is a willing subject.

There are two avenues through which this educating program can be carried on: first, through trade publications, edited for the education of the contractor; and second, through local associations of general contractors who are in a position to note plainly the evolution of irresponsible men.

Educate the Public

It is entirely possible that the irresponsible contractor may be indifferent and be unwilling to assume any of the better qualifications of a contractor, or he may be beyond the reach of the publication or the local association; in either case, the public and the bonding companies must be educated.

In the case of building construction, the best medium through which to reach the public is the architect. If the contractor is to be given any consideration at all, architects must select bidders who are responsible. They must not allow bids from men who are not responsible to be held as a club over the heads of those that are, in order to get the price down. Reliable contractors are up against it time and time again where the architect does not pick a reliable group of contractors. He gets little men to figure jobs that are beyond them. They make errors and mistakes all the way through and come out with a low bid. Then the architect goes to some responsible contractor with a good name and holds over him the price of the other to jew him down. That is tried hundreds of times. That is something in which architects must be educated. They must be made to recognize the efforts which reliable contractors are putting forth to bring irresponsible men to their senses, and through them alone will it be possible to reach the private individual that is always putting all contractors in the same class.

The bonding companies can be of the greatest help in this elimination process. With all due respect to the bonding companies' representatives when they state that the prime requisite for a surety bond is honesty, almost every contractor knows of cases where men utterly without principle or pretense of honesty have secured surety bonds because they had a large statement or a silent partner who had. Bonding companies stand in the way of a general clean-up of irresponsible contractors. They do not always demand skill, integrity and responsibility as the primary factors; they demand a financial statement. Of course, they might take some moral chance on a man who has all the first-class qualifications except a financial statement. The question is, what percentage do they refuse when the man has a first-class statement and no other qualifications? Judging from my observations, I will say it is very small indeed.

It is usually easy to approach every type of contractor except the one who believes that he can buy and hire every qualification necessary to make him a responsible contractor.

Factors of Failure

If you trace the failures in the contracting business, you will find that the greater part of them are due to lack of experience, judgment and honesty, rather than to lack of capital. Experience and judgment will not overstep the limits of capital. It is entirely possible to acquire money over night, but most of the other qualifications must be obtained by hard and honest efforts.

ACKNOWLEDGMENT.—From a paper read before the Building Division at the Annual Meeting of the Associated General Contractors of America, Los Angeles, Calif., February, 1923.

Mechanical Labor-Saving Devices on Road Work

By W. S. Cumming

County Highway Engineer, Monroe County Road Commission, Michigan

THE labor items in road construction are, approximately, 50 per cent of the total cost, and in maintenance this item runs as high as 75 per cent of the total cost. The cost of materials going into the work in maintenance or construction is practically a fixed figure. The first cost, including freights on materials, remains unchanged, no matter what efforts are put forth for a reduction. With one of the charges fixed, namely, material charges, it is easy to see that if the "cost of doing work" is to be lowered, the decrease must come in the reduction of the labor items. A considerable reduction can be made by the substitution of some mechanical labor-saving devices.

The Truck-Dumping Chute

One of the first successful devices made to save labor was a dump chute on the rear of our trucks for placing the slag in uniform piles at regular intervals along the side of the road. The attachment was worked out by a local trucking contractor and, I believe, was first used in the county in 1919.

This detachable chute consists of a U-shaped trough inserted between the end of the dump body of the truck and the open tail-gate, the chute being made long enough so as to extend beyond the right rear wheel about 12 inches. On this 12-inch extension there is a sliding gate, which the operator opens in order to allow the material to pass. By trailing a string or wire of the required length behind the truck, piles can be placed at required distances. One man in addition to the truck driver is all that is necessary to unload the truck. This chute places the material in neat, symmetrical piles the proper distance from the center of the road and out on the shoulder far enough so as not to interfere with traffic, and, at the same time, keeps the material together, thus reducing the percentage of waste. We feel that at least two men have been saved by the use of this chute, and that the running time of the truck has been increased at least 20 per cent. Our average cost per square yard for unloading, hauling and placing slag in piles was slightly less than ½-cent. This last year we placed three of these chutes on our trucks at a total cost of $103.80, or practically $35 apiece.

Chip-Spreading Wagon

In the construction of macadam roads, one of the greatest needs for labor is in the spreading of the chips after the large stone has been keyed. This is usually done by spreading from the piles on the side of the road. In 1920, some experiments were made by converting a manure spreader into a chip spreader. A new manure spreader was used in this experiment. Instead of being carried on a traveling floor, the chips were conveyed to the rear of the spreader by means of a double chain belt, upon which were fastened 1½-inch angle irons. At the rear of the spreader was a special revolving drum with horizontal compartments. As the chips reached the end of the spreader, they dropped into the horizontal compartments of the revolving drum, and from there were thrown out, spreading a strip about 4 feet wide. A hopper box was built on the spreader, increasing the capacity 1½ yards. The wheels were widened from 6 to 12 inches. This was done so as not to destroy the mechanical bond in the No. 1 stone. Steam rollers pulled the spreader.

The idea as represented in this machine is very good and one that can be used economically if some loading device, other than filling the wagon by hand, is available. The chips were spread evenly and the quantity was so regulated that there was no chance for matting. The machine cost, originally, $125, and in the experiment about $300 more was used before it was pronounced a serviceable machine. This machine, along with a mechanical loading device, not only does the work better, but replaces about four men in the operation.

The Cement-Concrete Pavement Breaker

Our pavement breaker consists of an old 2-ton truck with a 6-horse gas engine and hoist mounted on it for the power unit, and a driving hammer device on the rear for the working unit. On the rear of the truck, about 20 inches from the rear axle, 13-foot

leads were fastened to the chassis by means of an A-frame built up on each channel of the truck frame. On the face of the 950-pound hammer is a 4-inch tool steel point. In moving the truck any distance, the leads are dropped forward, the pivot pin being at the top of the A-frame. Just back of the truck seat, a square frame was placed. This was used to rest the leads on when in a traveling position. It is also used to anchor the 2 x 4-inch supports to the leads when in a working position.

In operating this device, the hammer is raised only about 3 feet from the pavement and there allowed to drop. In no instance does the flat surface of the hammer hit the pavement. Just as soon as the point has pierced the pavement, the truck moves to its new position.

One of the greatest expense items in the maintenance of the Dixie Highway, north of Monroe, was the breaking out of the patches by hand labor. With this breaker, as much work could be broken out in 2 hours as 7 men could break out in 2 days. The machine, on an average, operates about 2 hours per day. By the substitution of this device in the place of hard sledging labor, we are able to break out, dig and replace the patches in the same day.

Central Mixing Plant

The central mixing plant is located about 3 miles north of Monroe. It consists of a 27 E-Foote mixer placed on a ground level. A portable steel building, with a capacity of 2 cars of cement, was placed adjacent to it, and the aggregate was hauled by trucks to this point and from the cars on the railroad sidings at Monroe and from the quarry. The wet concrete was transported in Ford trucks, and, in no case, even on the longest haul of 10 miles, did we have any evidence of initial set or any serious trouble in the segregating of material in the bodies of the trucks.

The maintenance of this 14 miles of concrete had increased over the previous year about 360 per cent. The same number of men were employed in 1922 as in 1921 when the cement, water and aggregate were hauled to each patch and there mixed and placed. Assuming that the organization of 1922 would have been as efficient as the organization in 1921 under the old method, then, through the introduction of this paving breaking device, together with the adoption of the plan of the central mixing station, approximately $30,000 has been saved to Monroe County.

The Blower

One of the essential conditions under which it is possible to get a good bituminous treatment on macadam roads is that the surface shall be perfectly clean. Very satisfactory results have been obtained by the use of a horse-drawn rotary sweeper and with the hand brooming of the surface. With the idea of doing away with this class of labor and, at the same time, improving the condition of the surface for the application of the bituminous material, we did considerable experimenting in blowing the surface clean. This was first tried out in cleaning small holes for bituminous patches. The patches were made either with the cold patch material, or with a hot mixture. We found that by using a small bellows we could free the hole from all the objectionable dust and fine chips.

We then mounted a 6-horse gas engine on an old 2-ton truck. This engine was used to drive the fan of an ensilage cutter, which was also mounted on the chassis of this truck. By turning the fan at about 900 revolutions per minute, we were able to get a blast of air, which was laid to within 4 inches of the road surface through 6-inch pipe. By this means, sufficient force was obtained to clean the road free from dust and chips. The air blast had its greatest effect upon a strip about 2½ feet wide. Then, by running the machine up and down the road, commencing at one edge and blowing over to the opposite side, we were able to get the surface of the road in excellent condition for the application of the bituminous material. In doing this work, if there was any breeze blowing, the first trip of the machine was made on the windward side of the road so that there would be no chance for the dust and chips to be blown back by the wind on the portion cleaned.

In preparing a road for its first treatment, especially if in a thickly populated section, the people living on the road should be notified to keep all the windows and doors closed. A dust cloud of no small dimensions is formed by the blower and is quickly blown from the right of way. In order to assist in loosening any droppings on the road, wire brushes, placed on a frame, are lowered just in front of the rear truck wheels. Then, by two to four trips with the blower on each strip, the road is soon made ready for the treatment. In most instances, we found that the edges of old treated roads were very hard to clean. The earth from the shoulders and the sweepings from the road seem to form a more or less hardened mat at the edge of the metal. To assist in removing this mat, a triangular frame about 18 inches on each side was built, with spikes extending through it. This frame was fastened to the side of the truck and there pulled through the matted matter along the edge, so as to engage the spikes in the mat. Then, with a small amount of loosening, a sharp blast of air would clean the edges very satisfactorily.

By comparing the cost of cleaning on roads where the blower was used with the cost of sweeping the surface of roads by the old method, we found a saving of 2/10 of a cent per square yard. Although we are very glad that we have reduced our cost per square yard on this operation, if the cost had been the same, or slightly greater, the results obtained in treating a surface free from dust would more than offset the additional cost.

ACKNOWLEDGMENT.—From a paper read at the Ninth Annual Michigan Conference on Highway Engineering, at the University of Michigan.

How Much Time Is Lost in Delays in Concrete Highway Construction?

By H. K. Davis
Chief Inspector, Iowa State Highway Commission

IN the state of Iowa during the last two years some studies have been undertaken to determine what is average production on the standard types of construction equipment on highway work. On excavation and embankment work in that state the wheeler and slip-scraper are practically obsolete and no longer appear on the job, except for very special purposes such as sand cuts or constricted spaces. The same is true of the fresno, except for borrow-pits or side hill location. Steam shovels are seldom used except in connection with rock work, and in Iowa this is a small percentage of the whole. The result has been to limit the investigation of average output to the elevating grader, so far as dirt work goes.

On pavement construction the mileage of all types other than concrete has been so small during these two years that figures made on these jobs would be of very little value for purposes of comparison. The studies on paving, therefore, were confined to concrete. On the earthwork studies, while some valuable data were collected on averages, not enough information was at hand to enable us to account for all lost time.

LOST TIME IS EXPENSIVE

Help Eliminate Waste Time

"There can be no debate about the expensiveness of lost time on construction work. The engineering force on the job is there and cannot be used for any other useful purpose as a rule, during the idle times. No increase in the engineering personnel would ordinarily be required if the lost time were eliminated.

"Also, the contractor in order to continue being a contractor must make a living from his business, and it is impossible to hoodwink ourselves by trying to believe that the cost of his lost time is not charged to the work.

"It would seem to be a matter of common interest among all concerned, to join forces and do whatever is possible to eliminate waste time. All would profit in the end—the engineer by reputation for efficiency, the contractor by increased output, and the public by reduced costs. Even the machinery manufacturers and material men have an interest, in the increased demand for their products."

The figures here submitted deal with 151 miles of concrete placed in 1921 and 101 miles laid in 1922, not a large program in either year. The merit of the material, therefore, lies not in its mass, but in the fact that it was complete and covered average conditions over the area studied, also that it covers all the work done during the two years and not a few particular jobs which might be selected to verify a preconceived theory.

Working Conditions

In 1921 the season, so far as working conditions were concerned, was about what could usually be expected:

1. Weather conditions were about what can usually be expected. The spring opened early and work started, but much time was lost immediately by late snows and rains. Midsummer weather was good, but one extended spell of rain in the fall lost some three weeks of time for all contractors then at work. Winter held off a little later than usual.

2. The labor supply was good and dependable.

3. Shipping facilities were more nearly normal than at any time since pre-war days, and caused no delays that are of record.

4. A supply of material adequate to the needs either existed or was developed for the occasion. On only one or two jobs were they delayed for lack of materials to an extent that was noticeable.

5. The work was well distributed over the entire state. Therefore conclusions drawn from these figures are not limited to a small area where conditions might be very special.

6. The work was well distributed as to size of jobs. No one contractor secured any large block of work in any one location.

In 1921 the work was carried on 31 contracts, by 19 contractors, using 29 outfits, on 35 separate sections of road in 17 different counties. In 1922 the work was carried on 20 contracts, by 13 contractors, using 19 outfits, on 24 separate sections of road in 10 different counties. The term "outfit" is here used to include all loading, mixing and hauling equipment and their crews, which were operated as single construction units.

In 1922 the working conditions could hardly be called average in certain respects:

The weather was a little better than is usual in Iowa. There were no long rainy spells. In addition, winter held off for nearly a month longer than can be depended on as a rule, thus enabling several contractors to finish their work

when otherwise they would have had to shut down.

In all other respects the conditions were as favorable as in 1921 except as regards railway facilities. Because of the coal and shopmen's strikes many outfits were laid up for long periods waiting for delivery of materials when these were plentiful at the producing plants.

In all respects except the latter two the conditions under which these two years' work was done are considered about average for the Middle West, and there may be a lingering suspicion in the minds of some of us that a state of business stagnation caused by labor strikes is coming to be more nearly the normal than the abnormal condition.

Sources of Information

The figures here summarized were compiled from daily inspection reports sent to the general office of the Highway Commission by the inspectors on the jobs for every day that the job was under way, regardless of whether any work was done. These reports give the information usually contained in such reports as to feet run per day, cubic yards, cement content, etc., but in addition show the amount of lost time and the reason for such delay, from the start to the finish of every job. The information contained in the reports was tabulated by heading a column for each construction outfit with a brief description of the work and the equipment, and following down the column with the feet laid for each day, entering on the same line the reason for any delay that occurred on that day. The runs for a given date show opposite to each other on the same line for the entire state. Delays of less than about 45 minutes are disregarded, as they are considered a part of the day's work and too small to influence materially the day's run. The runs are given in linear feet, since in the great majority of cases the pavement is 18 feet wide and of a uniform depth of 8 inches. A very simple conversion factor is furnished by the fact that one linear foot of 18-foot pavement represents 2 square yards of surface.

Incidentally, it may be stated that this method of tabulation has the merit of permitting rapid comparison between all the outfits concerned for any given day or period of time. A state-wide rain shows up plainly on the progress made throughout the entire state on that date. Also it shows up in a rather startling manner the power of recovery of the various outfits after such a rain. Those organizations that are well-known for their pep almost invariably stage a quicker comeback than the easygoing ones. When two outfits work side by side and conditions are similar and the weather the same, and one outfit fails to work more than about half the time while the other produces steady results day after day, the natural conclusion is that the difference lies in the kind of management brought to the work by the contractor.

Another point frequently claimed, but not as yet proved by the Iowa date, is that an industrial railway haulage outfit can be run more days in the season than a truck-haul outfit when the two are operated under the same or equally good management.

Length of Construction Season

In 1921 the first concrete laid was on April 8; the last on November 16. This covers an interval of 223 calendar days, which has been taken as the length of the construction season for the most venturesome contractor.

In 1922 the first concrete was laid on April 27; the last on November 29. This made a construction season for 1922 of 217 calendar days.

Both of these seasons are considered to have extended a little later into the fall than can regularly be counted on, though only the 1922 season included a greater number of suitable work days than the average.

In the construction season of 1921 the 29 outfits laid an average of 27,525 linear feet of pavement each, or about 5.25 miles. In 1922 the 19 outfits averaged 28,021 feet each, or 5.30 miles.

In fairness to the contractors on the work it must be stated that this average output for a long season's work is not representative of their producing capacity. This is clearly shown by the fact that several outfits have turned out from 10 to 15 miles in a single season. It is explained by the fact that under existing highway laws Iowa is frequently compelled by the financial situation of the counties to let pavement contracts in units smaller than what would constitute an economical length of run for an outfit for the season.

Average Performances

The average length of season per outfit required by the contractors in 1921 to complete their undertakings was 114.3 calendar days, indicating a reduction of nearly 50 per cent from the possible total of 223. As intimated, this reduction is chargeable to the conditions under which the work was let rather than to any unwillingness or inability on the part of the contractors to carry on for a full construction season. In 1922 the average duration of time on the work was 100.8 calendar days, or considerably more than a 50 per cent reduction from the possible 217 calendar days. In any case where a contractor was able to finish his season's work within the construction season it is difficult to see how he can in fairness be charged with the failure to work through an entire season. The findings are reversed when, because of lack of foresight or good management, he fails to make use of all the available time in starting his work in the spring or in running late in the fall, and as a result fails to finish.

In 1921 the average output per outfit per calendar day was 241 linear feet. This shows how small a figure should be used in case it is ever desirable to use calendar days as a basis for figuring. In 1922, however, the average per calendar day was raised to 278 linear feet.

When Sundays and legal holidays are eliminated from the total calendar days in the season a more logical basis for comparison results. In

1921 with the Sundays and holidays eliminated there remained 96.1 possible working days on the average. The resulting run figured on this basis was 286 linear feet. In 1922 the possible working days average 85.7, and the run per day 327.6 linear feet. These runs reduce to about 600 square yards per possible working day as an average for the 2 years.

Eliminating all rainy days and other stops of an entire day leaves 74.1 days per outfit on which concrete was actually laid during the season of 1921. By the same process the days actually worked during 1922 reduces to 61.2, and not all these days were full days, since many of them show only short runs when rain, breakdowns, etc., stopped the work for the remainder of the day. It came as a distinct surprise to most engineers and contractors in Iowa to find that all the concrete pavement laid in 1921 could have been placed in 2.5 months of straight time, and the entire 1922 program in 2 months, if only the numerous delays could have been eliminated. Yet the work occupied the time of all the contractors and all the engineers for most of the year.

The average laid per day worked also seems like a very conservative figure. In 1921 it was 371.5 linear feet. In 1922 it rose to 457. This increase is very probably accounted for in part by better management and increased efficiency. But another factor is present which is known to be responsible for the major part of it. This is the increase on the average size of the plant equipment. During 1921 the largest outfit on the work was equipped with a 21-E paving mixer or a plant mixer of equivalent capacity, while there were several smaller than this. In 1922, there was only one mixer smaller than a 21-E and several large outfits came onto the work with mixers as large as a 2-cubic-yard capacity.

The figures here obtained, if conclusive, indicate that 800 square yards of 8-inch concrete is a safe estimate of the daily capacity of a paving outfit on the average, unless the size of mixers is increased, the efficiency raised materially, or some method found of beating the weather.

The 74.1 average of days on which work was done represents 64.8 per cent of the 114.1 average calendar days in the season of 1921. In 1922 the 61.2 average days worked is 60.7 per cent of the 100.8 average calendar days. The writer recalls having asked one contractor's superintendent what in his judgment was the per cent of time a man might safely count on as available in a construction season. After some thought he gave it as his opinion that 80 per cent was the most that anyone could rely on. To verify his statement, his outfit in 1921 came within 1.8 per cent of reaching the 80 per cent he had himself set as a mark. The nearest competitors his firm has had on the Iowa work in two years have not yet passed 74 per cent in days worked out of days spent on the job. Very few have passed 70 per cent, and many are around 50.

Classification of Major Delays

The days not worked were classified under various heads according to the causes for such delay. The per cent of the total calendar days thus lost was as follows:

	—Per Cent— 1921	1922
Lost on account of Sundays and holidays	14.20	13.67
Lost on account of snow, rain, mud and frost	14.70	9.72
Lost on account of breakdown of equipment	1.09	.47
Lost on account of shortage of material	1.14	9.83
Lost on account of moving equipment..	2.56	2.56
Lost on account of all other causes....	1.51	3.02
Totals	35.20	39.27

Attention is invited to the fact that a greater proportion of days were lost in 1922 than in 1921; also to the fact that delays due to causes within the control of the men on the job average about the same for the two years.

Those delays least subject to elimination by the contractor are the ones in which the widest variation shows between the two years. For example, the weather was more favorable in 1922 and contractors lost 4 per cent less of their entire time from this cause than in 1921. On the other hand, the railroad situation in 1922 caused shortages of material which delayed the contractors nearly 9 times as much as in 1921, and caused them to lose 8.7 per cent more of their total days. This quickly ate up all time saved on all other causes and left them behind as much as they otherwise might have been ahead.

Sundays and holidays and weather, as might be expected, make the largest draft on the contractor's available time. Breakdowns that cause a whole day's delay are rather noticeable by their absence. Apparently most up-to-date contractors have solved the problem of providing against delays of this sort by having on hand a stock of repair parts and a good live man to see that they are used. The moving and re-erecting of equipment seems to take up a larger amount of time than most of us would suppose.

"All other causes" for days lost include shortage of water, shut-downs to do grading work, shut-downs by the engineer or inspector to correct defective work, shortages of labor, strikes, etc. They are each one so small as not to justify separate classification.

The fractional days lost are classified under the same headings as the whole days, with the exception of Sundays and holidays. The figures are as follows:

	—Per Cent— 1921	1922
Lost on account of snow, rain, mud and frost	12.41	10.31
Lost on acount of breakdowns of equipment	5.21	5.24
Lost on account of shortages of material	2.51	3.35
Lost on account of moving equipment..	1.58	3.78
Lost on account of all other causes....	4.55	6.70
Totals	26.26	29.38

These totals of 26.26 and 29.38 represent the percentage of days worked on which some considerable delay occurred due to some cause or other. The average of actual days was 19.55 for 1921, and 18 for 1922. Subtracting these from days actually worked, leaves 54.7 days for 1921 and 43.2 for 1922 as the total number of full days worked on the average by all the outfits in the state. On all the other days worked

occurred some considerable delay that prevented them from getting in a full day.

In an article appearing in the *Engineering News-Record* in May, 1922, the following paragraph appeared. It is repeated here as expressing the sentiments of the writer on this matter:

"The almost universal habit of engineers to give honorable mention only to their livest contractor, of contractors to mention only their best day's run, and of equipment concerns to advertise only the job where their equipment was highly successful, have all created false impressions of the possibilities of construction progress. The record run that an outfit can make once in a season is a poor criterion by which to judge the efficiency of the outfit. Yet the public, and to too great an extent the profession itself, have these figures in mind in judging a contractor's progress. Alongside such records the mediocre performance of the steady producer seems unromantic and uninteresting, but the fable of the hare and the tortoise is as true to-day as it was when first told."

The low efficiency apparently indicated by many of the figures here given may lead to the thought that the contractors of the Iowa pavement were a small-caliber bunch. While they in no instance set new marks for the contracting fraternity to shoot at, it is believed that they show that the organizations which have laid the Iowa pavements are well organized and alive to the necessities of their jobs.

One contractor between June 16 and July 30, inclusive, 45 calendar days, worked every day but the 7 Sundays and holidays, or 38 successive working days, laying in that time 20,658 feet of 18-foot pavement. This was an average of 543.5 feet per day, or 231½ cubic yards of concrete.

Another contractor, using two separate outfits, worked both outfits every calendar day for 34 successive days from September 21 to October 24, 1921, laying in this time 29,347 linear feet of 20-foot pavement 8 inches thick with integral curb and gutter. This was a total of 5.56 miles, or an average of 432 linear feet per day. Reduced to cubic yards, this made 218 cubic yards per day per outfit. Not the least interesting feature of this run was that a weighted average of the haul shows every ton of this material hauled a trifle over 5 miles. The bulk of it was hauled over a hill road containing seven adverse 6 per cent grades and many smaller ones. A large share of it was hauled up a single grade 9,000 feet long, a part of which was 6 per cent and which had a number of curves. Practically all the remainder was hauled up a grade a mile long, with several curves and some 6 per cent grades. To complete the difficulties, a move was necessary with one of the outfits. By bringing in an extra mixer the remainder of the equipment was moved 15 miles across country, and some pavement was laid on the same day.

One contractor using a 31-E paving mixer completed 11 miles of pavement in 1922 at the rate of 608 feet for every day he turned a wheel, and was at it 64 per cent of the time.

Another contractor finished 16 miles of pavement in 1922 at the rate of 714.5 feet for every day worked. He worked 67 per cent of the time and yet made two long moves by rail during the season. This same contractor finished his last job by a continuous run of 20 calendar days at the rate of 920 feet per day, laying 18,406 feet of pavement in this time. The working day of this outfit was 10 hours long, and this was seldom exceeded by more than a few minutes.

Runs of 1,000 to 1,200 feet are numerous, and 800 feet was the common thing with many outfits.

These data and conclusions have the very common fault of being destructive rather than constructive. The writer has no solution to offer for the problem presented; in fact, it probably has no single solution. The betterment of the conditions noted will more likely come through the gradual whittling down of the delays at every point by the united efforts of all concerned.

The duty of the engineer in the matter seems clear. It will be his function to point the way, inasmuch as in his hands lie most of the facts and figures, or the opportunity to collect them. In this connection it is the desire of the writer to appeal to others more favorably situated than we are in Iowa, to keep similar records of lost time on highway work. Our program is small and our territory limited, while by extending this process to other states, soon a valuable mass of data would be on hand.

ACKNOWLEDGMENT.—From a paper presented before the American Road Builders' Association, Chicago, 1923.

A National Exposition of Interest to Builders

THE building industry, as a whole, will undoubtedly be greatly stimulated by the national exposition to be held on the Million Dollar Pier, Atlantic City, N. J., from June 16 to September 8, under the auspices of the American Home and City Beautiful Association. Everything that enters into the making of an attractive home, as well as a model city, will be displayed at this big exposition.

While at present there is a general boom in building construction, there may soon be a slackening in activity, and any project of far-reaching importance which is being held to create new interest in architectural beauty and construction is bound to have a wholesome effect on the industry in general. This exposition will be replete with exhibits under the following main groups: public and private buildings; materials, equipment and furnishings; the City Beautiful, embracing municipal improvements, hygiene, sanitation, and fire and accident prevention; pure food products, confections and beverages; the gardens, seeds, supplies and horticultural accessories.

Service Through Catalogs

The catalogs and pamphlets listed below are available for free distribution. Contractors and Engineers who check over these pages each month and write for such material as interests them, will find this a valuable means of keeping up to date on the subject of machinery and equipment.

SPEED UP THE CONCRETE MIX

The catalog of the Jaeger Machine Co., 701 Dublin Ave., Columbus, Ohio, describes the Jaeger positive mix, which gives a batch of concrete a minute, including loading, mixing and discharging.

ROAD MACHINERY FOR ALL NEEDS

The Good Roads Machinery Co., Kennett Square, Pa., has recently issued a new edition of its catalog, "Everything for the Road Maker," which it will be pleased to send to any contractor having road machinery needs of any description.

A GENERAL SERVICE CENTRIFUGAL PUMP

The American Well Works, Aurora, Ill., has recently issued a folder describing its American EEFD General Service centrifugal pump, which is a compact, efficient, self-contained, single-stage centrifugal pump operated by a New-Way engine, run by kerosene or gasoline, and which has many applications for contracting service.

SHOVEL FACTS

In a well-illustrated 24-page booklet entitled "Shovel Facts," the Ames Shovel & Tool Co., 90 Ames Bldg., Boston, Mass., describes the manufacture of Ames hand shovels, spades and scoops for all contracting uses.

MOTOR TRUCKS FOR ROAD WORK

The General Motors Truck Co., Pontiac, Mich., has issued a 16-page booklet, "Money-Saving Transportation for Road Construction and Maintenance," which contains considerable information on the construction of concrete pavement and the usefulness of motor trucks in this work.

QUICK DUMPERS FOR WHEELED SCRAPERS

Kost-Kutter wheeler-dumpers, which are tripped by the driver and make it possible to drop one or two men from your pay-roll, are described in detail in the circular which may be secured from the Kost-Kutter Equipment Co., Sidney, Ohio.

AN OIL-BURNING ENGINE FOR CONTRACTORS

The Hercules Corp., Engine Div., Dept. B., Evansville, Ind., will be pleased to send to any contractors complete information regarding the Hercules oil-burning engine, a thoroughly tried-out dependable, durable oil engine that has no carburetor, magneto, battery, coil, spark plugs, or wires, uses any fuel, and is claimed to operate more economically than any ordinary gasoline or kerosene engine.

SAVING MONEY IN RIBBED SLAB FLOORS

Bulletin No. 210, issued by Blaw-Knox Co., Pittsburgh, Pa., describes the new Blaw-Knox removable pan system, which makes possible many savings in the construction of ribbed slab floors.

PAVERS WITH FULL-LENGTH CAST STEEL TREADS

Catalog 8, issued by the Foote Concrete Machinery Co., 1241 S. Michigan Ave., Chicago, Ill., describes in detail the Multi-Foote road paver, giving illustrations of the paver in service and complete specifications.

ASPHALT FILLER FOR BLOCK PAVEMENTS

A new booklet which contractors may secure from the Asphalt Sales Dept., The Texas Co., 17 Battery Pl., New York City, describes the use of Texaco asphalt filler for brick and vitrified block pavements, from the arrival of the asphalt on the job in barrels and drums to the spreading of the material and the admission of traffic to the new pavement.

A PAYING INVESTMENT IN TRACTORS

"Monarch Facts," an interesting publication issued by the Monarch Tractors, Inc., Watertown, Wis., illustrates and describes the usefulness of Monarch tractors as well as their super-power and simplicity of construction.

STAUNCHNESS A TRACTOR NECESSITY

Whether it be the 10-ton Caterpillar tractor that will do almost anything in the heavy-duty field, or the 5-ton for speedy low cost work, the Holt Mfg. Co., Inc., Peoria, Ill., in its booklet "Caterpillar Performance" tells about the staunchness of each one of the machines and their many uses in the various contracting fields.

A GREATER RANGE IN A SINGLE TRENCHING MACHINE

The new rotary auxiliary cutter, a special feature of the Buckeye trenching machine that increases considerably the width of trench which can be cut by a single machine, is described in literature which may be secured from the Buckeye Traction Ditcher Co., Findlay, Ohio.

THE BACKBONE OF CONCRETE ROADS

The catalog of the National Steel Fabric Co., 709 Union Arcade, Pittsburgh, Pa., is a valuable discussion of concrete road reinforcement which will be found useful by all engineers, highway officials and contractors interested in good, modern, reinforced concrete road construction.

PAINT FOR STRUCTURAL STEEL WOORK

Booklet 148-B, issued by the Joseph Dixon Crucible Co., Jersey City, N. J., describes in detail Dixon silica-graphite paint, a natural combination of flaked graphite in pure boiled linseed oil.

PAILS FOR CONTRACTORS

Iron Horse Metalware catalog No. 921, issued by the Rochester Can Co., Rochester, N. Y., describes the three styles of contractors' pails made by this company, as well as a wide variety of other metal ware regularly used by contractors.

WATER-METERS FOR EVERY CLASS OF SERVICE

In the literature of the Pittsburgh Meter Co., Pittsburgh, Pa., contractors and municipal purchasing agents will find a great deal of information regarding Arctic frost bottom meters and all other types of water meters, as well as those for gas, oil, air, gasoline, oxygen, hydrogen, acetylene and other fluids.

WHAT MACHINERY MEANS IN BUILDING GOOD ROADS

The Russell Grader Mfg. Co., Minneapolis, Minn., in its catalog describes the complete line of road machinery which it builds for road construction, maintenance and repairing, including seven sizes of road machines, three sizes of elevating graders, maintenance patrol machines for both motor and horse power, scarifiers, road-drags, drag and wheel scrapers, draglines, gravel screening and loading equipment, culverts, steel beam bridges, etc.

HIGH-QUALITY PORTLAND CEMENT

Contractors interested in high-quality portland cement should secure prices from the Pennsylvania Cement Co., 131 E. 46th St., New York City.

A DOUBLE DRAINAGE TRAP FOR BUILDERS

Catalog F, issued by the Josam Mfg. Co., Canal Road and L. E. & W. R. R., Michigan City, Ind., describes in detail the Josam double drainage trap and drain with adjustable eccentric bushings, which are particularly helpful to building contractors in meeting distortions or irregularities in receptors when they will not coincide with "roughed in" connections.

ASPHALT TOOLS AND HEATERS

The complete line of asphalt tampers, pouring pots and heating kettles carried by Littleford Bros., 500 E. Pearl St., Cincinnati, Ohio, is described in detail in the latest catalog.

HOW DO YOU APPLY BITUMINOUS MATERIALS TO ROADS?

The latest literature of the Kinney Mfg. Co., 3529 Washington St., Boston, Mass., describes the Kinney method of applying hot or cold bituminous materials to roads in construction work or maintenance or for dust laying.

A SEMIPORTABLE LOW-COST CABLEWAY

Sauerman Bros., 438 S. Clinton Street, Chicago, Ill., have brought out a small semiportable dragline cableway, which will appeal strongly to contractors having small material-handling jobs. This cableway is described in detail in the latest literature issued by this company.

INDUSTRIAL LOCOMOTIVES FOR ROAD WORK

Minster locomoti es, which are built to serve well and economically, of any gage and from 2- to 8-tons capacity, are described in the catalog of the Industrial Equipment Co., 910-916 Ohio St., Minster, Ohio.

STEEL PAVING GUARDS

Godwin steel paving guards, made to protect the edges of streets, roads, curbs and street railway paving, are described in illustrated catalog No. 23, which may be secured from the W. S. Godwin Co., Inc., 12 E. Lexington St., Baltimore, Md.

HIGH-GRADE ROCK DRILLS AND COMPRESSOR OUTFITS

Waugh rock drills and compressor outfits are known as among the leaders in equipment of this type for contractors. The literature of the Denver Rock Drill Mfg. Co., Denver, Colo., describes these outfits in detail.

BITUMINOUS HEATERS THAT DON'T LEAK

Connery non-leakable tar and asphalt heaters are well known to many road contractors. The 10-gallon kettle has special features that are described in illustrated material which may be secured from Connery & Co., Inc., 4000 No. 2nd St., Philadelphia, Pa.

SAVE MONEY WITH A STONE SPREADER

The literature of the Burch Plow Works Co., Dept. B-4, Crestline, Ohio, tells what contractors think of the Burch stone spreader and the Burch car unloader, both of which are money-saving tools for road contractors.

HANDLING CRUSHED STONE, SAND AND GRAVEL FROM CARS

In the catalogs and price lists of the Universal Road Machinery Co., Kingston, N. Y., contractors will find a complete description of the Reliance portable car unloader for handling crushed stone, sand and gravel from railway cars.

EXPANSION JOINTS ARE PAVEMENT INSURANCE

Full information and prices on the use of Ideal expansion joints for providing for expansion in improved pavements in a convenient, safe and economical manner, may be secured from the Waring-Underwood Co., Commercial Trust Bldg., Philadelphia, Pa.

CONCRETE CURB REINFORCEMENTS

The use of Truscon curb bars to protect and reinforce concrete curbs is described in detail in literature which may be secured from the Truscon Steel Co., Youngstown, Ohio.

HEAVY-DUTY TRUCKS FOR GENERAL CONTRACTORS

The Garford Motor Truck Co., Lima, Ohio, manufacturers of motor trucks from 1- to 7½-tons capacity, will be pleased to confer with contractors having heavy hauling problems and will send literature describing Garford trucks for construction work.

TWENTY-FOOT, PORTABLE CONVEYORS

A 20-foot troughed belt conveyor with no skirt boards, which makes it possible to handle sand, gravel, crushed stone and other abrasive materials without damage to the edges of the belt, is described in detail in the literature of the Robins Conveying Belt Co., Park Row Bldg., New York City.

TILTING TRAILER MIXERS

The reasonably-priced Packard tilting Ford trailer mixer of the American Cement Machine Co., Inc., Keokuk, Iowa, is described in detail in the literature of this company, which will be of interest to many contractors needing small mixers.

A 4-CYLINDER MOTOR ROAD ROLLER

The Acme Road Machinery Co., Frankfort, N. Y., has brought out a 4-cylinder motor road roller with an air-pressure controlled scarifier which makes a particularly useful machine for road contractors.

CALCIUM CHLORIDE FOR ROADS

Many contractors do not appreciate the value of calcium chloride in road work. It hastens the set of concrete, reduces its freezing point, thus extending the construction season, and when spread over the new surface of concrete holds the moisture and perfects curing. "How to Cure Concrete," issued by the Dow Chemical Co., Midland, Mich., gives complete information.

CAST IRON PIPE THAT IS EASY TO LAY

Contractors called upon for emergency jobs in laying cast iron pipe lines will do well to secure full information regarding Universal cast iron pipe, made in 6-foot lengths and requiring no pouring, no calking and no bell holes. Literature may be secured from the Central Foundry Co., 41 E. 42nd St., New York City.

IT PAYS TO USE COMPRESSED AIR

Bulletin 22-AC, issued by the Domestic Engine & Pump Co., Shippensburg, Pa., tells road builders and contractors just why it pays to use compressed air in drilling rock, removing hard clay with pneumatic spades, bush hammer finishing of concrete bridges, etc., using Domestic portable air compressors, which are complete self-contained units.

A SIMPLE, RUGGED STEAM SHOVEL

The new ¾-yard contractors' steam shovel, known as the Model K, recently brought out by the Fairbanks Steam Shovel Co., Marion, Ohio, is described in detail in literature which may be secured by interested contractors free on request.

PROTECT YOUR WATER-SUPPLY

W & T chlorine control apparatus, known the world over for its able work in applying chlorine as a sterilizing agent to municipal water-supplies, is described in detail in various booklets which may be secured from Wallace & Tiernan Co., Inc., Newark, N. J.

INFORMATION ON CAST IRON PIPE

The U. S. Cast Iron Pipe & Foundry Co., Burlington, N. J., will be pleased to send descripti e literature on cast iron pipe, fittings and castings to any interested contractors.

CONCRETE MIXERS FOR BETTER WORK

The reason why Smith mixers are used on jobs from the smallest to the largest for the production of good concrete at good speed, is told in the literature of the T. L. Smith Co., 1013 32nd St., Milwaukee, Wis.

A STANDARD BUILDING MIXER

The No. 7-S Ransome standard building mixer, mounted on trucks with a gasoline engine, power loader and automatic water-tank, is described in the latest literature of the Ransome Concrete Machinery Co., 1772 Second St., Dunellen, N. J.

GRADERS FOR HEAVY-DUTY WORK

Contractors interested in securing a grader which they can be sure will stand up under the hard work to which it is subjected, should write for the literature of the Stockland Road Machinery Co., 3326 27th St., E., Minneapolis, Minn.

SELF-LOADING SCRAPERS

Catalog 96-A, which contractors may secure gratis from the Baker Mfg. Co., 585 Stanford Ave., Springfield, Ill., gives specific reasons why contractors can use Baker-Maney self-loading four-wheel scrapers to advantage on dirt-moving jobs.

WHEELBARROWS THAT MEASURE LOADS

The No. 80 measuring barrow, made in 2-, 2½- and 3-cubic-foot capacities, with either steel or wood handles, for contracting service, is described in detail in literature which may be secured from the Sterling Wheelbarrow Co., Milwaukee, Wis.

EASILY INSTALLED EXPANSION JOINTS

Elastite expansion joints, which are easy to install, are durable, absorb the stresses of expansion, and have other advantages, are described in the literature of the Philip Carey Co., 9 Wayne Ave., Lockland, Cincinnati, Ohio, which also includes installation details.

Two Methods of Handling Basement Excavation

A GMC TRUCK USED BY EXCAVATING CONTRACTOR FOR REMOVING MATERIAL FROM BASEMENT EXCAVATIONS

T. L. SMITH EXCAVATOR BEING USED BY A. F. TOLLMAN, OF ST. LOUIS, FOR BASEMENT AND CELLAR EXCAVATION

This machine, sold to the contractor by the George F. Smith Co., St. Louis, Mo., stays on top of the ground alongside the hole, bringing the dirt from the cellar to the machine and from the machine into the wagon. This does away with sending teams or wagons into the hole and also does away with the expensive gang of hand shovelers, as only two men are required with the machine, one on the machine and one in the cellar loading the scraper

Get Enough Money for Your Work

By Ransom Rowe
President, New England Road Builders Association

ROAD builders are now submitting bids on road-building projects all over the country and, as in the past, many mistakes and errors are in evidence, made by contractors whose years of knowledge and experience should teach them differently. I have been neither more nor less a victim of these conditions than others who have made road construction a large part of their work for the last 15 or 20 years. In this time the approximate value of money involved in highway contracts performed by the writer would run to over five million dollars. With the experience gained in handling this large sum of money and being actually in touch with directing and carrying out all the contracts, one would think that a recent error of judgment of what a contractor should receive for building a few miles of standard common roadway would be impossible.

Of course, some things come up during the life of a contract which cannot be anticipated by even the wisest, but they should be provided for to some extent, and money should come out of the contract items to cover these aggravating contingencies. Let me cite one example. On one road contract amounting to nearly $200,000, it was necessary to borrow $35,000, expecting, of course, to pay it back as the work progressed. This money was for pay-roll and supplies, and very little for new equipment. As matters turned out, no part of the loan could reasonably be paid within the time first planned, and probably will not be paid for one year from the date of the obligation. This one item for interest alone will be $2,100, not thought of in making up the bids, but it is a fair, legitimate charge whether the money is borrowed or possessed.

In reading over contracts, one cannot expect to have his attention called to things of this kind, but if attention was called, the actual amount would be entered against this item by all bidders, and—depend upon it—other items in the bid would not suffer or cheapen in consequence. The same reasoning applies to bonding charges. On a $200,000 job, the bonding companies' charge is $3,000. If an item in the contract allowed you that amount, do you think many would bid less for excavation or concrete or filling? We all know this bonding charge is often lost sight of.

A contractor doing considerable paving in the past year was being pressed for money by some of his creditors and was explaining to them his financial condition by saying that he would have plenty of money if the engineers had been more liberal in their estimates, or, in plain words, paid him for all the work he had done. His case was looked into, and it was established without any doubt that his contention was groundless and the cause of his embarrassment was not the fault of the engineer. The real reason was that the contractor was not getting enough money for his work. He had not taken into consideration the many expensive items that contractors are confronted with now as never before.

Another practical instance is that of a contractor who had the reputation of being a safe, conservative bidder and who submitted the lowest tender on a section of concrete highway, a Federal Aid project, amounting to a great many cubic yards of concrete, the other items also being large—as quantities run in highway construction. He was congratulating himself on what appeared to be a good job. The bidding was close and he won the work by a very narrow margin. When he was looking over the work with other contractors a few days before the letting, a sand and gravel pit was pointed out to them where the material looked excellent. Samples were taken and they passed the 7-day test. Mr. Jones, as we will call him because that is not his name, at once got onto his job and at two of the sand and gravel locations erected costly and efficient cleaning and crushing plants. About that time the Federal men took samples of the aggregate to a laboratory for the 27-day test. When Jones was ready to start his concrete work, a report was received from the Federal authorities that the material was not up to their standards and must not be used. They would, however, make more tests and hoped for better results. To make it brief, the material was rejected. It was good, but did not reach the point set up in the Federal requirements, and there is no appeal from

HOW CONTRACTORS' ASSOCIATIONS CAN HELP

Ransom Rowe, well-known contractor of Boston, Mass., suggests that the road builders' organizations which exist throughout the country might well establish a service for members which would take a great deal of the gamble out of road contracting. He suggests that one or two men be employed to examine and study all proposed jobs to be let in their respective territory, the results of their work being available to members of the association as a check against their own estimates and bids.

that. The result was that Mr. Jones, besides losing a lot of valuable time, had to import all of his sand and stone from a distance, meaning delay and a heavy loss. Mr. Jones was not getting money enough for the job, and that menace was in front of him from the first day. He and his other close competitors should have played safe on that item. If the authorities could not guarantee the material, enough should have been added to the bid to pay the extra cost of suitable material.

In almost every section of the country some sort of road builders' organization now exists. They have been formed for the purpose of rendering service to members and not for the purpose of attempting to control prices or to regulate the placing of contracts. These associations may do much in a fair and lawful manner to aid in putting the road-building industry on a more sound and businesslike basis than now exists. They may do much to discourage and eliminate some of the guessing and gambling.

An idea along this line that has occurred to me is that such associations of highway contractors might employ one or two competent men to make a study of the jobs proposed to be let in their respective territories, and to make up complete estimates, accompanied by a statement or explanation to show how the prices on each and every item were computed. This could then be made available to members for comparison with their own estimates and to provide a sort of check against them. After the bids had been received and opened, these association estimates could be furnished to the bonding companies, supply men and others as a guide to them, and they would soon learn by comparison what contractors were inclined to gamble and what contractors were safe and conservative. It would be somewhat expensive to finance a plan of this sort and put it into operation, and it would very likely be subjected to adverse criticism, but, if done, it would doubtless be the means of helping many contractors to get money enough for their work.

ACKNOWLEDGMENT.—From a recent article in *The Nerba.*

Kinds and Properties of Concrete Reinforcement Bars

By J. C. Sheperd
Laclede Steel Company, St. Louis, Mo.

AT the present time there are on the reinforcing bar market three kinds of bars, which may be classified as (1) rerolled bars, (2) billet bars, and (3) rail steel bars. Rerolled bars, because of their method of manufacture, have no particular range of physical characteristics. These properties will depend solely upon the kind of scraps from which any one bar happens to be rolled. Billet bars are produced in three separate and distinct grades, (a) structural, (b) intermediate, and (c) hard grade. Each has physical characteristics within the limits of the specifications under which each is manufactured. Rail steel bars are produced in one grade only, and the physical characteristics correspond to those of the hard grade billet bars.

Rerolled Bars

Rerolled bars are made from an assembly of all kinds of iron and steel scraps with the exception of cast iron, including bars, flats, small forgings, axles and such railway scraps as spikes, bolts and short pieces of rail. In piling this material the pieces of scrap are selected so that they fit together, and then they are heated to the welding temperature, at which point they are removed from the furnace and sent through the rolls. A bar produced in this manner cannot be uniform, either in its chemical or in its physical make-up. There has been no melting process, merely a welding, and in many cases the welding has not been complete, as oxides covering the scrap material prevent a perfect weld.

It is apparent from this method of manufacture that there can be no set physical characteristics for any group of bars; that is, a single test taken from any group of rerolled bars would not be indicative of the physical characteristics of any other bar in that group. In fact, a test at the end of one bar would not necessarily indicate the physical characteristics of any other part of the bar. For this reason there has been no attempt to write a specification covering rerolled bars. To-day they are rarely used for reinforcing concrete, with the result that the production of rerolled bars for this purpose has been practically discontinued.

Billet Bars

Billet bars are composed of pig iron and scrap handled in the open-hearth furnace to form steel, which is cast into an ingot and then cooled and removed from the mold. After this it is placed in the "soaking pit," where the steel is brought to a temperature for rolling. After rolling, the discard, or bloom, from the end of the rolled ingot is sheared off and taken to other rolling mills, where it is reduced into the desired shape. Some of the sections rolled from blooms are billets, rails and structural shapes, while others are allowed to cool and are sent to the shop to be hammered into forgings.

Billet bars are produced in three grades—

structural, intermediate, and hard grade. The structural grade bar is soft, having comparatively low elastic limit and tensile strength. The intermediate grade is harder than the structural and has relatively higher elastic limit and tensile strength. The hard grade bar is still harder than either of the others and has still higher tensile properties.

Probably no one knows the reason for the demand for these three different grades of bars for reinforcing concrete. The answer might be—the preference for one or another grade by different engineers. Then arises the question, "Why the difference of opinion among engineers?" Without reflection upon the preference of the engineer for any one grade, we submit the following as showing the logical development of the three different grades of bars.

Before concrete came into use as a building material and steel was used, the engineer had become familiar with that material rolled into I-beams, channels and other shapes which were made from low-carbon steel and from its use termed structural steel. This steel was soft because primarily it had to go through a very severe fabricating process of cutting, punching and riveting. It was natural, therefore, with the beginning of concrete construction and the demand for reinforcing steel, for engineers to require bars rolled from the same grade of material that was formerly used in all building construction. However, engineers were quick to recognize the fact that steel in concrete was not subjected to the same kind of stresses nor the same punishment in fabrication as structural steel. Consequently, for reinforcing purposes intermediate steel of slightly higher elastic limit and strength was developed.

The natural tendency was toward the use of a material of as great strength as possible, inasmuch as the prime object of the steel in the concrete was to take up the tensile stresses which the concrete itself was not capable of resisting. Further developments in the art of building concrete structures, and additional knowledge as to the stresses developed in various types of reinforced concrete work justified this tendency toward a material of greater strength, consistent with a sufficient ductility. Thus the demand for the hard grade reinforcing bar.

This tendency toward the use of steel of greater strength in building construction is further borne out by the fact that the structural people are now making a harder structural steel and are recommending the use of higher stresses in structural steel buildings.

The Development of Rail Steel Bars

With the demand for the hard grade reinforcing bar came, naturally, the development of the rail steel bar. Years prior to this time it had been brought to the attention of certain steel manufacturers that the railroads in this country were constantly increasing the weight of their locomotives and cars, necessitating frequent replacement of rails with those of newer design and heavier section. These steel manufacturers, after investigating the physical condition and properties of the rails removed from service, realized that it was an economic waste to remelt this material, and they evolved the idea of reclaiming it by rolling the rails into smaller sections.

This was a natural development, for billets and rails were originally produced in exactly the same way, so that it was a logical step to consider these rails as billets and to roll other sections from them in the same way that they were rolled from billets. It was found that the physical properties of these sections rolled from rails were exactly the same as those of the hard grade billet bar, so that in this way the rail steel reinforcing bar was developed.

Physical Properties of Reinforcing Bars

In the table below are given the minimum physical properties as required by the American Society for Testing Materials for each kind of reinforcing steel. The specifications for hard grade billet and rail steel are the same.

STRUCTURAL	
Tensile strength, lbs.	55,000
Elastic limit, lbs.	33,000
Factor of safety	2.06
Working stress, lbs.	16,000
INTERMEDIATE	
Tensile strength, lbs.	70,000
Elastic limit, lbs.	40,000
Factor of safety	2.22
Working stress, lbs.	18,000
Saving over structural, per cent.	11.2
HARD (RAIL OR BILLET)	
Tensile strength, lbs.	80,000
Elastic limit, lbs.	50,000
Factor of safety	2.50
Working stress, lbs.	20,000
Saving over structural, per cent.	20.0
Saving over intermediate, per cent.	10

Engineers of equal eminence differ in opinion as to which grade of steel should be used for reinforcing concrete. Suppose the working stress be 16,000 pounds for structural, 18,000 pounds for intermediate, and 20,000 pounds for hard grade (either rail steel or billet). This gives a corresponding factor of safety in each case of 2.06 for structural, 2.22 for intermediate, and 2.50 for hard grade.

The increase in the working stress has allowed a saving of 11.2 per cent if intermediate be used in preference to structural, or 20 per cent if hard grade be used in preference to structural. The use of hard grade in preference to intermediate shows a saving of 10 per cent. By using hard grade steel there has been not only a saving of 10 to 20 per cent in the amount of steel used, but an increase in the factor of safety of from 20 to 25 per cent.

ERROR IN MARCH ISSUE

The captions for the two illustrations on page 71 of the March, 1923, issue of CONTRACTORS' & ENGINEERS' MONTHLY are reversed. The upper illustration shows the Smith tilting mixer used by Keeley Brothers, of East St. Louis, as part of their central proportioning plant equipment, and the lower illustration shows the Insley mast hoist for chuting concrete to the wing walls and piers of a new concrete bridge.

Building the Million-and-a-Half-Dollar Weaver High School, Hartford, Conn.

Contractors Use Full Corduroy Crane for Handling All Materials

THE large ground area covered by the new million - and - a - half-dollar Weaver High School, Hartford, Conn., presented a serious problem to the contractors, the H. Wales Lines Company, of Meriden, Conn., in handling the concrete aggregate, and also the heavy stones, girders, and timbers in erection.

The concrete aggregate consisted of crushed gravel and sand and had to be unloaded by motor trucks within the confined area. In order to load this into overhead storage bins, either a bucket elevator or a crane was required. A bucket elevator would have served for the specific purpose of elevating materials from a predetermined point and would necessarily have been supplemented by auxiliary rehandling apparatus to take the discharged material from points within a radius of 70 feet of the bin and convey it to the elevator. A Pawling & Harnischfeger "206" full corduroy crane, sold to the contractor by the K. B. Noble Company, Hartford, Conn., solved this problem by depositing the gravel discharged by the truck on the right of the bin, at a parallel point 50 to 75 feet back of the bin, and the sand on the left of the bin, leaving a working aisle directly behind the center of the bin for the operation of the crane itself. Thus the three days or more per week when they were pouring concrete, the crane was able to keep the bin filled at all times, and when not handling aggregate to the bin, was employed in rehandling the aggregates dumped out of reach of the boom and in placing them in a working position at a minimum of expense.

GASOLINE CRANE SERVING MATERIAL BIN

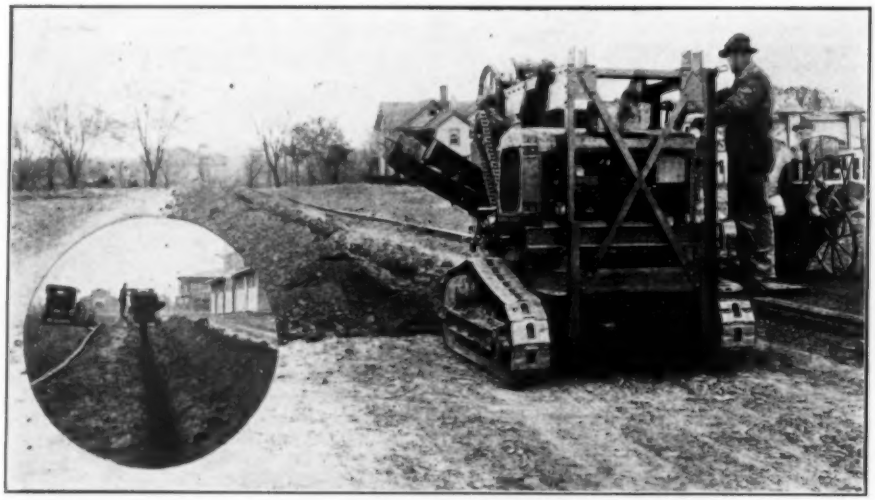
The operation of loading the material bins and discharging and rehandling to the pile was accomplished in from 18 to 21 seconds, using a ¾-yard Blaw-Knox Dreadnaught bucket, which carried a full yard of material at each load, thus handling practically 3 yards of material per minute. The crane not only proved economical in loading the bin and making it possible to place a measuring device for sand and stone between the bin and the mixer, but was even more economical on this project in being a real "handy man" in unloading steel, structural iron and reinforcement bars, in unloading trucks of lumber and in elevating cement bags and skips to the charging platform of the bin. As the work progressed on the upper part of the building, the crane was used in setting lintels and stone arches, and in handling groups of timber and economically depositing them at any predetermined point around the building. The work had previously been arranged so that the materials for that portion of the building were deposited within swinging radius of the crane boom. A clear way was left around the foundation of the building, making this possible.

As the first two stories rose, the crane boom was extended with a standard 12-foot extension, making a 50-foot boom. This was employed in the same manner in setting steel and timbers, and in handling materials, placing them exactly where they were wanted, instead of taking them up at several points, which would have required separate hoists and derricks. When the building reached the third story the boom was again extended to practically 70 feet, being topped in a closer radius, and the materials handled as before.

During the early course of construction and when not concreting, the crane was employed doing excavation work, rehandling cave-ins, digging special channels, and in innumerable other services, performing them efficiently and conserving a great deal of labor. The contractors have ordered a power shovel attachment for this crane, which will enable them to handle all of their own excavation work in the future.

A New Ditcher with Vertical Digging Boom

A VERTICAL digging, side-discharge type trenching machine, mounted on crawler traction with no auxiliary wheels, is a new development in ditching machines which has recently been brought out by the Barber-Greene Co., Aurora, Ill. This radically designed machine, which digs straight down and has a positive-discharge bucket, has been thoroughly tested by real work in the field for more than a year. The machine digs straight down to a depth of 5 feet and a width of either 7½ or 15 inches. The buckets are part of the chain, built to break as they pass over the head sprocket, thus insuring positive discharge of any kind of material.



A FORE-AND-AFT VIEW OF THE NEW VERTICAL DIGGING TYPE TRENCH EXCAVATOR, SHOWING TRENCH FOR GAS PIPE IN INSET

During the summer of 1922, after many factory tests, the ditcher illustrated was put to work digging trenches for the gas-mains at the new grounds of the Central States Fair and Exposition near Aurora. Here it dug 2 miles of ditch for gas-mains, averaging 600 feet per day through different kinds of soil, such as black loam, gravel, yellow clay and white clay. During this digging the machine encountered construction work on foundations, which necessitated running the gas pipe around the foundations. To do this, the machine turned four successive corners, each at an angle of about 70 degrees, without removing the boom from the trench. During this time the machine was operated by only one man.

The sturdiness of the machine was well demonstrated in that only two minor repairs were necessary and the replacement of occasional breaking pins, with which the machine was provided as a safety measure to protect it when large boulders were encountered. This low repair record of a new machine was possible because it was made up almost entirely of previously tested units. The crawlers on which it was mounted are the same standard crawlers used on the Barber-Greene Model 42 loader, and the Buda engine and Cotta transmission are also the same.

After the machine had finished its work at the Fair Grounds, it was brought to Aurora and used by the Western United Gas and Electric Company to replace a labor gang in extending the gas-mains of this company on Pierce Street. Here one operator replaced a whole digging gang, doing the work of 20 men, and, it is claimed, effecting a saving of about $75 per day.

Consult the "Where to Purchase" Section

CONTRACTOR'S AND ENGINEERS' MONTHLY is unique in its "Where to Purchase" Section, pages 3 to 45. Consult these pages whenever you wish the names of manufacturers of contractors' machinery or supplies.

Plans for a National Museum of Engineering and Industry

A JOINT COMMITTEE representing the four Founder engineering societies has been appointed to consider plans for a National Museum of Engineering and Industry. After hearing the claims advanced by those who favor New York, Chicago and other cities, the sponsors of the movement have decided to accept the offers of the Smithsonian Institute to establish at Washington a central "Historical Museum," in affiliation with which "live museums" will be developed in different sections of the country. The Joint Committee consists of Clemens Herschel and Nelson P. Lewis, American Society of Civil Engineers; Frederic A. Delano and Dr. George F. Kunz, American Institute of Mining and Metallurgical Engineers; Reginald Pelham Bolton and Holbrook Fitz John Porter, American Society of Mechanical Engineers; Edward D. Adams and Charles L. Clarke, American Institute of Electrical Engineers. Mr. Porter is acting Chairman of the Committee.

The museum is planned as a storehouse for the records of American engineering achievements and as an institution affording opportunity for research to the investigator and student. In character it will, it is said, be similar to, but larger than, foreign museums, such as the Science Museum at South Kensington, London, the Conservatoire des Arts et Metiers at Paris, and the Deutsches Museum at Munich.

Almost from the day the national engineering societies were founded, beginning with the organization of the American Society of Civil Engineers in 1852, they have been the repositories of symbols of the nation's mechanical and industrial progress. Unfortunately, through moving, and because of crowded quarters, some of the invaluable treasures of the engineering world have been lost, and the Founder societies have been forced to refuse proffered gifts of this nature.

The museum will meet the requirements of the various engineering societies and the national need for an establishment where the people can view graphically the steps in the development and utilization of mechanical power in the exploitation of the natural resources by means of which the United States has in 75 years advanced from an agricultural nation to world supremacy in commerce and industry. A study of the plans and administrative organization of foreign museums is under way. Coordination of local museums with the main museum at Washington will provide for the interchange of exhibits, photographs and descriptions, so that people of every section of the country may benefit from the collections in all the museums and become better acquainted with advances in engineering progress.

Handling Excavation in India

American Material-Handling Machinery Competes with Cheap Coolie Labor

AN interesting demonstration of American excavating machinery was recently held on the Worli Road, near Bombay, India. Before a company of distinguished engineers of the railroad company, the Military Works Department, the Sukkur Barrage, the Sutlej Irrigation project and the Sardha Caudl, a gasoline-driven excavator made by the Pawling & Harnischfeger Company, Milwaukee, Wis., was given the task of cutting a solid mass of hard shale. The shovel, with its powerful crowding motion, dug into the shale and had little difficulty in getting a full dipper-load at each bite. Afterward the shovel boom was removed and replaced with a dragline bucket, and then a sewer trench was excavated through practically the same kind of soil.

INTERESTING CONTRAST BETWEEN MODERN EXCAVATING MACHINERY AND MATERIAL HANDLING BY COOLIES

This method of excavation in India is in interesting contrast to the methods in common use where coolies do practically all of the work. The coolies refuse to dig with shovels, preferring to scoop the earth or other material up with the hands and place it in metal containers, which they carry upon the tops of their heads. Much of this kind of work is done by the women.

There is a considerable amount of work to be done in India and it is believed that the use of earth-moving machinery will stimulate more and

more improvement work because the cost of doing the work will be greatly lowered. Coolie labor, though cheap, is by no means economical, because of its notorious inefficiency.

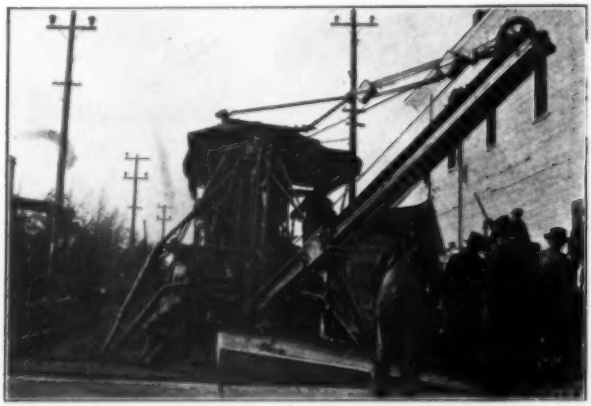
It is thought that the dragline in particular will have great application in India because there is a great deal of drainage and flood control work to which the dragline is admirably adapted. Indian engineers are disposed to pay much attention to American methods of excavation, as they feel that American engineers have solved problems similar to their own. They feel that a country whose engineers have so admirably carried through such tremendous undertakings as the Panama Canal and the Mississippi flood control can solve their engineering difficulties also. They have a very serious problem in the control of the Irrawaddy River in Burma, which overflows its banks annually, destroying thousands of acres of rice and also taking a toll of human life.

Another interesting advantage of the use of excavating machinery over hand labor, especially in the interior, is the fact that it lowers the number of deaths from cobra bites, which are said to total 20,000 annually in India. The excavating machine will be able to eliminate much of this loss.

Pre-cast Concrete Roads

A Hard-Surface Road That Can Be Made and Laid at Any Time

A CONCRETE road can be laid at any time of year, regardless of weather conditions, by the use of concrete slabs, providing that the slab is manufactured under shelter and moved to the location in sections. In a special road district in Joplin, Mo., oblong slabs, measuring 9 x 10 feet, 8 inches thick in the center of the road and 6 inches thick at the outer edges, are made in a yard and then moved to the road. These slabs weigh approximately 8,000 pounds each, or about 146 pounds to the cubic foot. One of the important reasons for trying this method of placing concrete roads was to eliminate the delay which frequently occurs in waiting for the concrete to set or season after the cement has been poured from the mixer. A certain amount of time is always necessary to finish up the surface of the concrete, and then it is necessary to cover it with earth or straw and allow it to set for periods varying from one to three weeks. This frequently means that the highway is tied up for a considerable period of time, to the great inconvenience of traffic. On the other hand, when the road can be made in sections or slabs, moved to location and set in place, it is ready for traffic immediately and the street can be opened without delay.



SETTING A PRE-CAST CONCRETE SLAB IN ROADWAY

The slabs in the above illustration are being handled from the truck to position by a Model 4 Keystone traction shovel made by the Keystone Driller Company, Beaver Falls, Pa. This machine may be used as a traction crane and can be equipped with three different kinds of buckets mounted on the boom. It is used with a skimmer on ordinary road grading jobs, with a dragline bucket on ditching work, and with a ½-yard clamshell bucket for unloading cars. Road contractors find it advantageous to have a shovel which can be adapted to a variety of uses and one which is readily portable by means of its own power.

NOT EVERY CONTRACTOR CAN WORK FOR NOTHING

Colorado Springs has recently completed the paving of 8 miles of city streets under conditions that are of unusual interest to every community. The pavement was laid by the Colorado Springs and Interurban Railway Company, the local street car utility, which was under a contract with the city to do the work at actual cost. In addition to accomplishing the work at a figure which is about $200,000 less than the lowest contractor's bid, the street car company has just turned over to the city a complete paving plant, valued at $90,000, making a total saving to the taxpayers of $290,000.

Pneumatically Bushed Cast Stone

ARTIFICIAL or cast stone has found a wide call from the architects for use in the construction of modern buildings. It is the desire of the architect and engineer in many instances to bring out in effect on the cast or artificial stone the resemblance of a granite surface. On constructions where this character of stone is used, in order to make the finish more effective, the specifications call for the surface to be pneumatically blushed.

The illustration represents a wonderful example of cast stone with tooled or bushed surfaces. The building is the new home of the Atlantic Refining Company, on South Broad Street, Philadelphia, a twenty-story structure. All four sides of the first five floors of this building are erected of cast stone manufactured by the Benedict Stone Corporation of New York City.

A NEAR VIEW OF THE ATLANTIC REFINING BUILDING PHILADELPHIA, PA.

The specifications in this instance called for a reproduction of the granite surface. The stone was left with the original sand face as it was pulled out of the molds, and came to the work in sections, and after it was completely set the bushing or tooling was started.

The Benedict Corporation employed in this work the standard Dallett Fingergrip type of bushing tool, manufactured by the Thos. H. Dallett Company, Philadelphia. As chisel equipment, a point chisel was used, consisting of nine points for the surfacing of the outer sand face or skin, and a wide single-blade chisel for finishing.

The ornamentations on the cornice, as noted on the front view illustration of the building, were tooled over. The indentations and moldings of the carvings were cleaned up so as to make them stand out as though they were cut from solid formation.

A comparison between the tooled or bushed surfaces and the original sand face of the stone can be made on the illustration showing the tools in operation on a suspended scaffold. The whole work, when completed, was very pleasing and brought out the desired effect. To the observer, the first floors appear to be of granite structure, so closely were the specifications followed out by the contractors.

The four sides of the five floors of cast stone represent 31,800 square feet of surface. The exact figures of daily production are not available, except that it is known that the 15 men employed in the bushing of the structure were averaging more than 40 feet each in an 8-hour day.

The Benedict Corporation made special preparation for the bushing of this work, providing a compressor with ample capacity for the operation of fifteen of the Dallett bushing tools. The air supply pipe was carried on the cornice of the second floor. This pipe was 2 inches in diameter and had leaders at convenient intervals, so that the hose lines could be readily attached. The Dallett hose sections were 50 feet in length, which permitted ample freedom for the operation of a tool at any point in the height of the work. Swinging scaffolds with canvas covering gave a certain amount of protection to the workmen, and, incidentally, confined the dust.

COMPARISON OF TOOLED AND UNTOOLED SURFACES

The Part of the Motor Truck in Road Construction

Its Service in Central Mixing Plant and Central Proportioning Plant Methods

THE first method employed in the construction of concrete roads was to unload the aggregate ahead of the mixer at the side of the subgrade and from this supply to charge the mixer by means of wheelbarrows. This method has become obsolete. State highway engineers now prohibit the dumping of aggregate along the subgrade in their specifications, as dirt and other foreign matter get into the mixture and weaken the strength and quality of the concrete.

The two standard methods now used are known as the central mixing plant and the central proportioning plant methods. In the first method the aggregate is completely mixed at the plant, transported to the subgrade and applied in a wet form. The central proportioning plant is rapidly gaining favor, however, with both the highway engineer and the contractor. In this method dry batches of gravel and sand are mixed at the plant. The cement in most cases is transported separately to the subgrade. By means of motor trucks these dry batches are transported to a portable mixer located on the subgrade. The batches are divided by a partition in the dump body, each carrying the proper proportion of dry aggregate. With this system it is possible to accurately control the mixture of the concrete and keep it clean from dirt and foreign substances.

The condition of the subgrade in most cases makes it very hard to operate a motor truck, as it is often soft and extremely rough going because of grading work. These conditions necessitate a medium-size motor truck with minimum turning radius, equipped with pneumatic tires, and with a capacity of two batches of dry or wet aggregate, two batches being equal to the capacity of the standard concrete mixer. The Ruggles Road-Builder truck, made by the Ruggles Motor Truck Company, Saginaw, Mich., has been designed to meet these conditions.

The outstanding features of this new truck claimed by the manufacturers are adequate motive power, a well-balanced truck, short wheelbase, short turning radius, pneumatic tires, and a special low-gear ratio providing unusually high tractive effect for subgrade work. It was particularly designed for use with a standard 21-E concrete mixer and is equipped with a dump body carrying two batches of wet or dry aggregate. The flexibility of this truck permits it to be shifted quickly from one job to another. It can be used as a unit for grading and gravel work, and after the road-building season is closed it may be used for coal delivery, or, by removing the body and installing a fifth wheel, it may be converted into a tractor for hauling semi-trailers, thus making it an all-season machine.

ROAD-BUILDING TRUCK READY TO RECEIVE LOAD AT SNOW-COVERED GRAVEL PIT

The truck is built with an underbody hydraulic hoist and dump body, or an automatic gravity dump body. For contractors who handle dry aggregate, the dump body is divided by a center swinging partition to handle two-, four-or five-bag batches. For wet aggregate the center swinging partition is removed. For contractors who handle gravel and earth a 2-cubic-yard dump body is supplied with a double-acting tail-gate and spreading attachment.

It Pays to Build Mud-proof Roads

Nearly 2,500 persons in 500 automobiles who went over the new Chintoteague Island bridge, south of Richmond, Va., when the roadway was opened, were marooned on the island when trying to return. A sudden heavy rain made quagmires out of the recently constructed road. Oozy mud, hub-deep for miles, made progress impossible, and most of the machines were forced to pass the night where they stood. Hundreds of cars loaded with men, women and children were unable to move. Farmers were busy all night hauling the machines out of the mire with mule teams.

GET THE FACTS

The "Caterpillar's" field of usefulness is by no means limited to road-making. There is a "Caterpillar"* of size and capacity for every power need. On farm or ranch, in the mining, oil and lumber industries, for snow removal and other civic work—wherever tractive power and endurance are at a premium, the "Caterpillar"* has no real competitor.*

Holt has been building tractors for years and knows *how*. Because of our broad experience in the road-making, contracting, industrial and other heavy-duty tractive fields, Holt construction and Holt performance are everywhere accepted as standard. Holt's principles of design, quality of materials and unmatched workmanship have stood the test of world-wide service. That means something, doesn't it? Working on any kind of contract or road job the "Caterpillar"* has repeatedly proved that it has no equal for getting things done. Henry Cullom, contractor at Dallas, Texas, *knows:* "The 'Caterpillar'* has a better getaway under constant load and for the stops and starts encountered in pulling an elevating grader; it is the most readily handled and the most comfortable to operate; it follows the furrows closer and is more flexible than any other tractor built. Contractors and public officials are entitled to know the facts straight up as I know them." Let us give you more facts about the "Nation's Road Maker" for *your* job.

** There is but one "Caterpillar"—Holt builds it. The name was originated by this Company, and is our exclusive trade-mark registered in the U. S. Patent Office and in practically every country of the world.*

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An Improved Method of Reinforcing Concrete Roads

Self-Supporting Deformed Bars Insure Proper Distribution of Steel in Concrete Roads

THE last three or four years have witnessed a decided change in the attitude of highway engineers toward the reinforcement of concrete roads, and there has been a great deal of serious thought given to the subject and many important investigations undertaken.

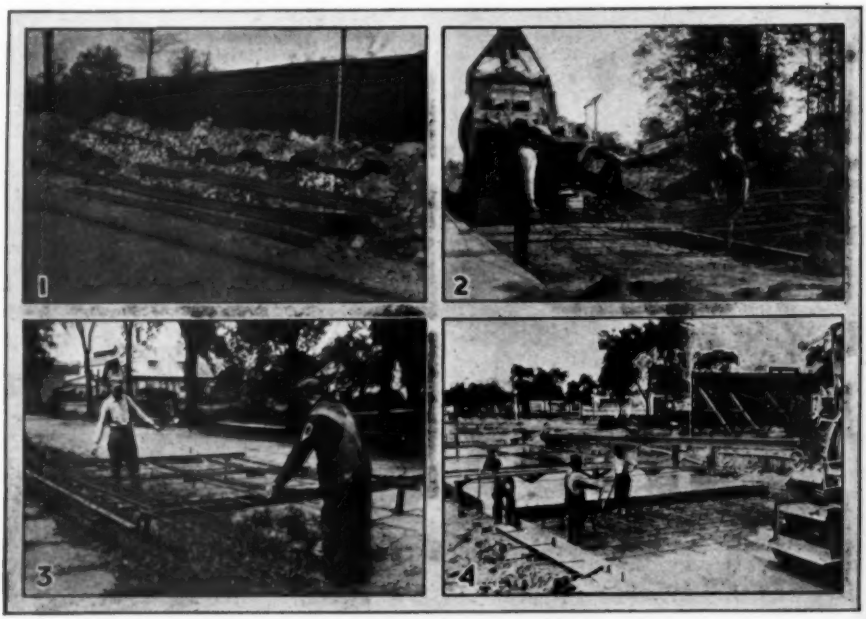
Within the last two years, several of the eastern states have faced the issue frankly and have employed a much heavier reinforcement of several different types. The results of this work have been so successful from the standpoint of lowered maintenance, improved appearance, better riding qualities and moderate cost, that it seems that the problem of the design of our concrete highways has been solved. The roads which are now being built should last for an indefinite period with an extremely low cost of up-keep, and when surface wear makes resurfacing necessary, they will form an ideal foundation for either a thin reinforced concrete surface or a wearing surface of some other material.

In the development of an economical type of reinforcement for roads, the Concrete Steel Company, 42 Broadway, New York City, has played its part in creating the Havemeyer deformed steel bar system. This system consists of steel reinforcement cut to length and shop-bent where required, which is assembled into units or mats in the field by the use of a portable assembly frame, and tied at the intersections with "Bar-Tys." The mats are so formed in most cases that they support themselves in the correct position on the subgrade and require no preliminary concreting or screeding.

The steel, both bent and straight, is shipped to the work in bundles, and the Bar-Tys in boxes containing 1,000 ties and weighing about 40 pounds per box. Where desired, a portable assembly frame which requires only bolting together to prepare it for use is furnished to the contractor.

Field Operations

The steel, Bar-Tys and assembly frame are received at the nearest railroad siding, hauled



BUILDING UP AND PLACING MATS OF REINFORCING BARS

1. Bundles of reinforcement piled beside road for State Highway, Pelham Manor, N. Y. 2. Placing double type mat built up of deformed bars on subgrade on White Horse—Yardville Road, Mercer County, N. J. 3. Assembling reinforcement on frame for road in South Nyack, N. Y. 4. Mat in place, ready to receive concrete on Sheridan Road near Grace Street, Chicago, Illinois

Monarch Industrial Model C Pulling 10 Foot Grader

Grading is the most uncertain item of cost in the Contractor's estimate. Overestimating may lose a profitable contract. Under-estimating may result in a serious loss. With a

MONARCH INDUSTRIAL TRACTOR

for dependable power, the Contractor may accurately predetermine his costs of grading work.

There is a Monarch Model for all road building jobs.

Model C—4-40, 6-60

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MONARCH TRACTORS, INCORPORATED

Watertown, Wis., U. S. A.

"The Monarch is the most dependable Crawler Tractor."

The Monarch builds good roads and keeps roads good.

Monarch Industrial Model C Scarifying Hard Road

to the work and distributed along the roadway. The assembly frame is set up at a convenient point near where concreting will be commenced, and the steel is assembled in the frame and tied by two laborers, using the Bar-Tys to lock the bars together. When completed, the mats are lifted out of the frame and piled along the road ready for use. After sufficient mats have been fabricated in one position, the frame is carried down the road to a new location and the process repeated.

As the concreting plant moves down the road, the mats are lifted by two laborers and placed directly on the subgrade behind the mixer, lapping the ends of the longitudinal bars with the projecting end of the reinforcement which is already in place. The section is then concreted in the usual way, just as if no reinforcement at all were employed.

Advantages of Self-Supporting Bar Reinforcement

The advantages claimed for this type of reinforcement are: flexibility of design; positive location of the steel reinforcement in the slab; positive mechanical bond of deformed bars; reduced number of laps, due to longer sections of reinforcement; a choice of grade of steel—structural, intermediate, or hard—at the same cost; reliable source of supply and prompt shipment; ease of handling and hauling; no field protection required; reduction in cost of placing and cost of concreting; and a lower total cost to the contractor.

The Cost of Sandstone Excavation

IN a recent issue of *The Scraper*, J. S. Walton, highway contractor, discusses the cost of sandstone excavation in Kentucky, giving a compilation of the actual costs of taking out a small sandstone cut, exclusive of profit. This job is typical of the rock excavation met with in highway grading and drainage projects, for the nature of the work calls for a team outfit for the earth work, and the rock encountered is so scattered that it is necessary to take it out by hand and team.

On this job a gasoline-driven portable air compressor with a jackhammer was used. The sandstone, because of the sharp grit, was very destructive on the drill steel, necessitating frequent sharpening. The haul on the excavated material was favorable, averaging about 250 feet. The rock was hard to drill, being mixed with dirt seams. It was found that this type of sandstone, while fairly soft, requires closer spacing of drill holes and heavier charges of powder than hard limestone.

TOTAL COST

Supt. labor and teams	$1,040.77
Insurance	35.39
Cost of dynamite, caps, transportation and storage of same	307.81
Use of compressor, freight, etc.	128.92
Sharpening steel	44.85
Total	$1,557.74

There were 811 cubic yards of this material, making the cost of excavation $1.92 per cubic yard, exclusive of profit.

If You Lose Money, Your Industry Suffers

BY losing money yourself, you will never contribute to the benefit of industry in general. An unwise bid, even on the part of the most responsible contractor, hurts the construction industry. "Do not bid too low" is just exactly as beneficial a slogan, so far as the industry and the public are concerned, as is "Do not raise costs by striving for great selfish profits."

When the subcontractor has put in a season and, after the manner of his own figuring, sees a very skimpy margin of gain, there is something wrong which should be righted. And be it inserted right here that ofttimes when the subcontractor does see a skimpy margin, the services of a cost accountant would acquaint him with the fact that even the skimpy margin is not there. It has been eaten by overhead and other factors he forgot to figure in.

There is much said about relations with subcontractors. There need be nothing said if men recognize the Golden Rule and bid with understanding. Price cutting on the part of material men, ill-advised bidding on the part of contractors, gouging the subcontractor, are dead weights on progress.

The aim of each factor of the industry should be to make a decent profit, and to do this by proper charging and not by skinning some unfortunate to recoup a loss which should be borne by the loser because he did not do that which would forestall the loss.

No one should be in business for his health, neither should anyone be in business parasitically, that is, to make money off the mistakes of others. See to it that you can make a legitimate profit. Then take upon yourself the much bigger and harder task of making all others in the construction industry see the same thing. The vast amount of building which is being done should, in general, render profits to the materialmen all along the line, to the subcontractor, and to the general contractor; but this will never come about until each of the above recognizes the universal cooperation which should exist. How shall this cooperation be secured? The answer lies with you and with each of the associations to which you belong.—*The American Contractor.*

ENDURANCE

ENDURANCE is the ability to bear and continue in spite of destructive forces. In this respect Newport Culverts are pre-eminent in the culvert field. Made of GENUINE, OPEN-HEARTH IRON (99.875% pure copper alloy), these culverts are the most rust-resisting on the market.

In strength, they have never been found wanting, for under the heaviest fills, with the greatest loads, they have carried the burden without deformation. They are guaranteed to last longer under identical conditions than any other corrugated metal culvert pipe.

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Newport Culverts endure the ravages of time and rough usage for decades. Let us explain further why we thoroughly believe there is no better culvert made. Send us your name and address.

Newport Culvert Company, Inc.
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A Moving Central Proportioning Plant

Special Mounting Makes It Possible for Contractors to Overcome Unusual Conditions

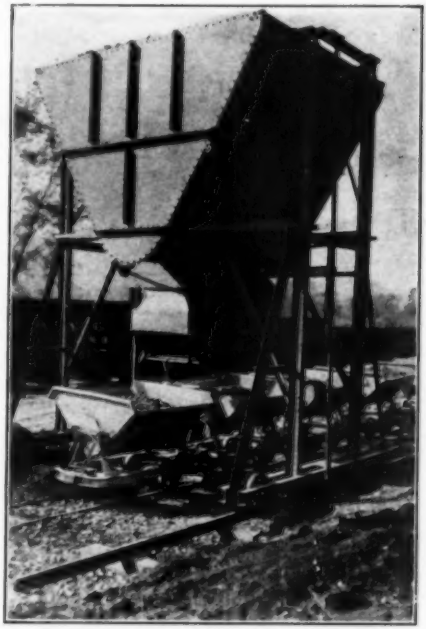
A UNIQUE performance in placing a central proportioning plant on wheels, so that its location could be readily changed, is credited to the R. D. Baker Company, Detroit, Mich., on its road contract at Cochranton, Pa. The plant was a standard Blaw-Knox 30-ton bin and measuring batchers.

At the time this job was under way, conditions for road building were anything but favorable. Railroad facilities were poor and trunk roads in bad shape. The contractors could not afford to risk delay in shipments caused by freight car shortage. To solve this problem, all aggregate was stored in a pile 1,000 feet long, and parallel with this pile a short section of track was laid, over which the contractor moved his central proportioning plant mounted on wheels. By this method the bin was always close to the material and was kept filled with the least difficulty.

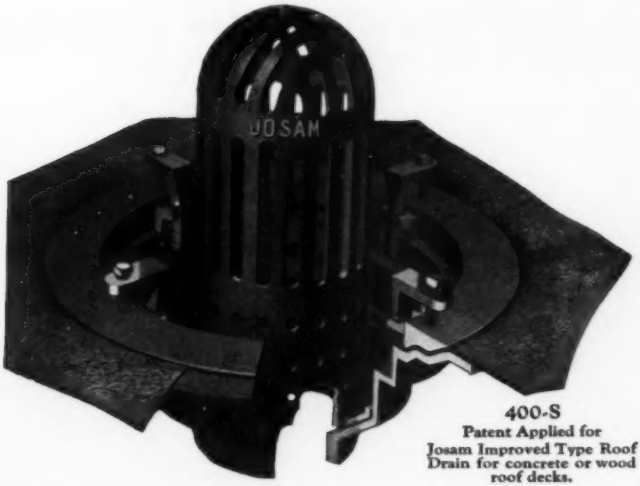
Materials were carried from the bin to the mixer in a train of hopper cars. The aggregate had to be proportioned for two types of roads, one of concrete and the other a bituminous surface on a concrete foundation, in mixes of 1:2:5 and 1:1½:3. The batchers were adjusted to measure off the necessary quantities, one stone batcher being adjusted for 18 cubic feet and the other for 15 cubic feet. Once set, the batchers worked accurately and speedily, so that only one man was required to operate the entire proportioning plant. By pulling a lever, he releases the flow of material into the batchers and then by pushing back this same lever, the material flow is shut off and struck off at the same time, leaving in the batcher the exact amount called for by the specifications. A pull on another rope, and the material is dumped. As soon as the batcher is empty, the drop-gates close automatically and the operation is started on the next batch. The operation of the plant is so simple and speedy that there is no trouble in loading the industrial railway hopper cars while the train is in motion, thus saving the time usually lost in stopping the locomotive and starting it again for each separate car.

At this rate of speed, the stock pile was soon exhausted and the batcher was put to a test for portability. It was moved to a second and a third set-up. One of these was at a distance of two miles, and the other ten miles. In spite of bad roads and a grade that amounted to 12 per cent in some places, the ten miles were covered quickly and the plant was ready for operation in its new location just five hours after it was moved from the first set-up.

These batcher plants are manufactured in three standard types—the trussed, the suspension, and the charging bins. The trussed bin is so called because of the interchangeable unit trusses which support the bin. It is furnished in capacities of 65-ton, 116-ton and 186-ton units, designed particularly for truck hauling and central mixing plants. In the suspension bin the storage contained is suspended on heavy columns and pillars and is standardized in units of 30, 50, 75 and 100 tons, with additional 25-ton units, and is especially adaptable for industrial hauling and central mixing plants. As indicated by its name, the third type is used for charging trucks or batch boxes, chutes, hoppers, etc., and has a storage capacity of 6 cubic yards, or 9 tons. Not only in road building, but in general contracting, the economy, speed and accuracy of this type of plant make it a valuable piece of equipment on the construction of buildings, foundations, walls, bridges, dams, sewers and other concrete structural work calling for the rapid and accurate proportioning of material for the mixer.



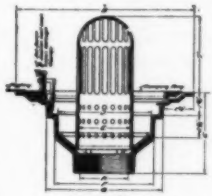
BIN AND MEASURING DEVICES MOUNTED ON WHEELS



400-S
Patent Applied for
Josam Improved Type Roof Drain for concrete or wood roof decks.

A New Roof Drain Development

MANY public buildings of every description throughout the country are equipped with Josam drains. Now Josam offers its latest achievement the 400-S roof drain. This is the drain that affords an *absolutely watertight connection between the roofing and the drain body without the use of flashing.* This is made possible by the improved type clamps and clamping ring which securely hold roofing into drain body without any danger of fracture to roofing felts.



Cross Section of the 400-S Roof Drain
Made with 2, 3, 4, 5, 6 and 8-inch Outlet.

The clamping ring is held securely in place by four adjustable clamping posts of manganese bronze which are tapped to receive a ⅜-inch galvanized set screw. Simply tightening these screws permits any desired pressure on the clamping ring, under which the roofing felts are clasped.

The 400-S Roof Drain is furnished with Josam removable combined sediment cup and strainer. The body of the drain has a total depth of 6¼ in. over all, making it applicable to all thicknesses of roofs.

Our Catalog F explains in detail the complete Josam line. Write for your copy.

The Josam Manufacturing Company

Factories: 2nd & Canal Road Michigan City, Ind.

Branches: New York, Cleveland, Chicago, St. Louis, Detroit, Seattle, San Francisco, Los Angeles, Washington, D. C., Boston, Buffalo, Albany, Atlanta, Minneapolis, Des Moines, Cincinnati.
Canada: Montreal, Toronto

"There are no Substitutes for Josam Drains"

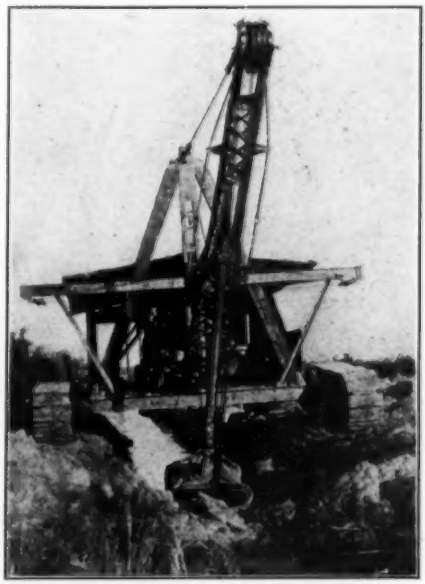
Josam TRADE MARK REG. DRAINS STANDARD OF AMERICA

One-Yard Crawling Dredge Cleans Up Orange Grove Ditches

THE Fort Myers Grove Company, Fort Myers, Fla., has 800 acres of orange and grapefruit groves under cultivation at the present time, and is developing about 2,000 acres additional. Part of the 800 acres which is now bearing fruit was drained by ditches some time ago, but the ditches needed cleaning badly and the construction of many new ditches was necessary. The rows of trees are only about 30 feet apart, so that it was necessary to use a method which would not damage the branches of the fruit-bearing trees in cleaning ditches.

The material to be excavated consists of hard-water sand overlying a stratum of lime rock. The ditches are comparatively small in size, running from 3 to 4 feet bottom and 8 to 12 feet top. This work could not have been done by a dragline machine, because of the hard material and rock. Furthermore, a steam shovel of the full-circle type was out of the question, as there was not room enough between the rows of trees to permit the machine to stand on one side of the ditch and revolve. The work was tackled by a Bay City land dredge, with caterpillar mounting, and a specially constructed dipper with manganese lip. This machine, made by the Bay City Dredge Works, Bay City, Mich., is now successfully digging the sand and rock without blasting.

The illustration shows the machine constructed to straddle the ditch, so that it handles both the clean-out work and the new excavation without being obliged to work from one side of the bank. The work is being completed without any injury to the rows of trees, and the machine is handling a much bigger yardage than was expected. Clinton Bolick, manager of the Fort Myers Grove Company, is enthusiastic over the performance of the dredge, which has completed the clearing of 1½ miles of ditch and the construction of ¾-mile of new ditch. Where there is no rock to encounter, they are digging from 700 to 775 cubic yards of material in a ditch with a 3-foot bottom and a 9-foot top. The machine was installed on February 26, 1923, and between that date and March 10 the work mentioned above was completed.



BY STRADDLING THE TRENCH, THIS DREDGE MAKES A QUICK CLEAN-UP

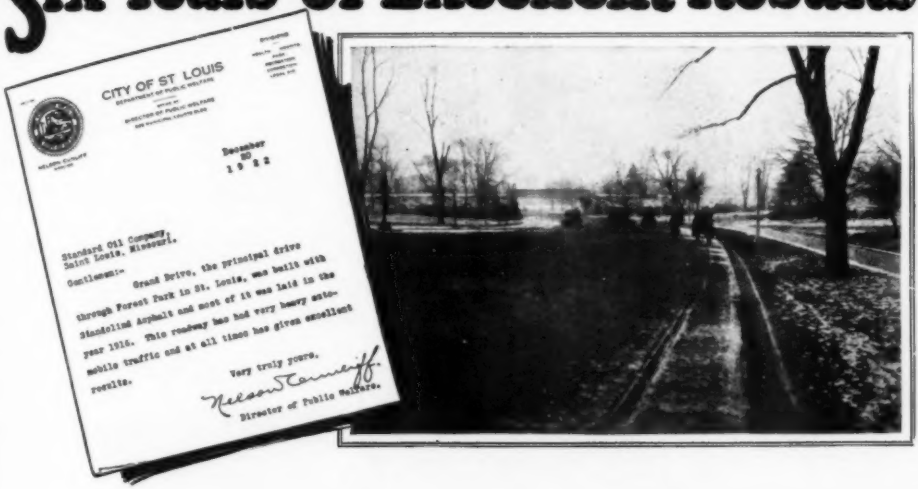
A Plan to Standardize Engineering Symbols and Abbreviations

THERE is hope that the great confusion, misunderstanding and the often serious errors which result from the use of one symbol or abbreviation for several terms and the use of several different symbols or abbreviations for one meaning in the various engineering fields are to cease, as the American Engineering Standards Committee at a recent conference has organized definitely to bring about a unification of technical and scientific abbreviations and symbols.

It is agreed on all sides that the standardization of abbreviations and symbols would result in inestimable mental economy. The present situation with respect to the use of abbreviations and symbols in engineering, scientific and other technical fields is comparable to the use of a language which has degenerated into a multiplicity of dialects, each of which has to be translated by the users of the others.

A recent conference, held under the auspices of the American Engineering Standards Committee, called, at the request of the American Institute of Electrical Engineers, the American Society of Mechanical Engineers and the Association of Edison Illuminating Companies, has decided that it will be desirable to include, as a part of the unification project, the graphical symbols which are used in engineering drawings, diagrams, and the like, for representing instruments and apparatus and components of them.

Six Years of Excellent Results


CITY OF ST LOUIS
December
1922
Standard Oil Company,
Saint Louis, Missouri.
Gentlemen:-
Grand Drive, the principal drive
through Forest Park in St. Louis, was built with
Stanolind Asphalt and most of it was laid in the
year 1916. This roadway has had very heavy auto-
mobile traffic and at all times has given excellent
results.
Very truly yours,
Director of Public Welfare.

Stanolind Paving Asphalt in St. Louis

THE advantages of using Stanolind Paving Asphalt are best told by one who has enjoyed actual experience with it.

In the above letter, Mr. Nelson Cunliff, well known in the middle west as one of the leading public officials of St. Louis, Mo., sets forth several reasons why it is to your advantage to pave roads and streets, for which you are responsible, with Stanolind Asphalt.

Forest Park Drive was built in 1916 with asphalt macadam (Penetration method), using Stanolind Paving Asphalt "C". This boulevard is one of the main arteries of traffic in St. Louis and is subjected to extremely heavy automobile traffic; yet note what Mr. Cunliff says about the excellent results it has given.

The photograph was taken in December, 1922, six years after the road was built, but, as the picture clearly indicates, it is now in as good condition as the day it was finished.

And it will still be in as good condition six years hence, for ***exceptional durability*** is one of the outstanding characteristics of roads paved with Stanolind Paving Asphalt. This factor, together with the low maintenance costs of such roads, makes Stanolind Asphalt the ideal road material.

We have recently issued a booklet which tells the latest methods of constructing and maintaining bituminous pavements. It will be sent to you free upon request.

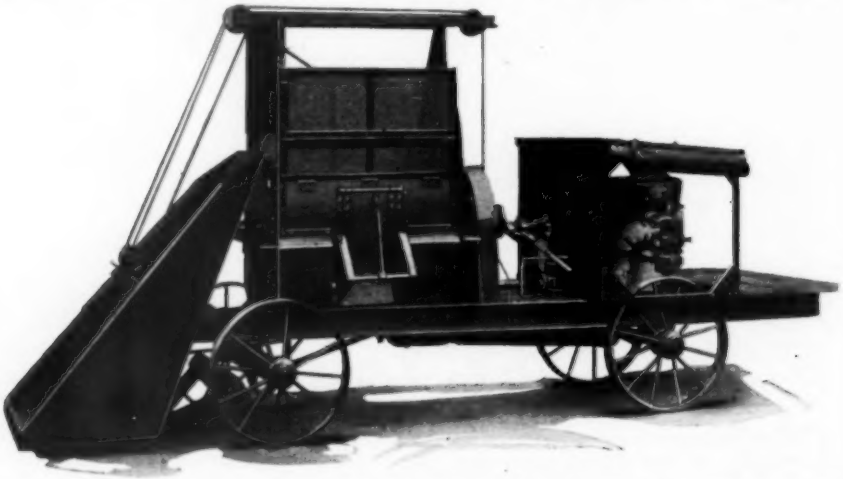
STANDARD OIL COMPANY
(INDIANA)
904 S. Michigan Avenue **CHICAGO, ILLINOIS**

A Complete Small Portable Hot Asphalt Mixer

A PROCESS has recently been invented for making hot asphalt mixtures quickly, easily and economically in small quantities. The Iroquois rapid mixer, recently brought out by the Barber Asphalt Company, Land Title Building, Philadelphia, Pa., is a compact machine, in which sand, filler and Genasco liquid asphalt are used. The first two are placed in the skip and then dumped into the Iroquois rapid mixer while the agitating blades are revolving. The liquid asphalt and two pints of gasoline are added and lighted with a match, and in six minutes, when the flame has died out, there is a 4-cubic-foot sheet asphalt mixture hot and ready to spread. Asphaltic concrete and asphalt macadam mixtures can be made in a similar manner.

This method is made possible by the new patented Barber process in conjunction with the use of Genasco liquid asphalt, which provides a material that when flashed will burn until the lighter fractions are burned off, leaving a hot asphalt mixture of a temperature of 250 to 350 degrees Fahrenheit, with no danger of coking the material.

The rapid mixer in this process is a complete bituminous repair plant that can be quickly operated and easily moved from place to place, and requires small space for storage. The entire plant can be mounted on a small motor truck chassis, if desired. In addition, it needs only two men to operate, and eliminates entirely the costly overhead of the larger plant, in which steam must be kept up and many other costly details attended to. The mixer measures only 15 feet 3 inches in length and 4 feet 7 inches in width, with a shipping weight of 5,200 pounds.



A MACHINE FOR THE ALMOST INSTANT PRODUCTION OF HOT SHEET ASPHALT MIXTURES

In addition to the mixer, the following small tools are supplied: two 8 x 6-inch tampers, two 10½ x 6½-inch smoothers, four asphalt shovels, two asphalt rakes, two asphalt cutters, and two rattan push brooms.

A roller is essential to insure proper compression of the various asphalt mixtures, and a 5-ton tandem is preferred. However, satisfactory compression may be secured by the use of a 1,000-pound hand roller with a compression of 50 pounds per square inch.

Standard Conveyor Purchases Brown-Portable Line

THE Standard Conveyor Company, North St. Paul, Minn., has announced that it has acquired by purchase all the rights, titles and patents pertaining to the Brown-Portable line of sectional piling, elevating, conveying, loading and unloading machinery for the handling of packed and loose material. This line of machinery has been manufactured by the Brown Portable Conveying Machinery Company at North Chicago for ten years. Until further notice the plant will be continued in operation, and all inquiries and correspondence regarding Brown-Portable products should be addressed to the Standard Conveyor Company, Brown Portable Products Plant, North Chicago, Ill.

The organization which has developed the Brown portable conveying machinery will continue with the Standard Conveyor Company.

For Heating and Applying under Pressure all varieties of Bituminous Materials, Hot or Cold, for Road Construction, Maintenance or Dust Laying.

Heat and volume under instant control of operator. Positive pressure produced by the Kinney Pump.

PATENT COMBINATION
Auto Heater and Distributor

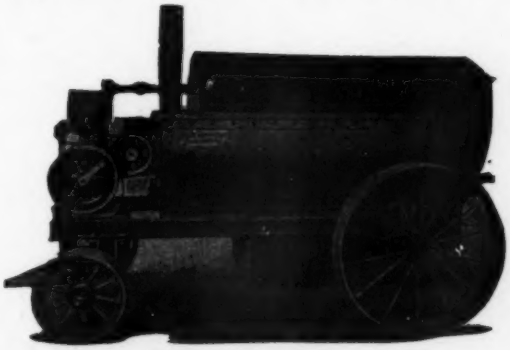
QUALITY
Kinney
EFFICIENCY

HANDY HEATER and SPRAYER

Especially adapted for Road maintenance, construction and general repair work. Contents constantly agitated while heating.

No burning or coking of material. Pump, Piping, Hose, Nozzles, Automatically Heated.

No Steam Required.



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Increased manufacturing and warehousing facilities enable us—the world's largest manufacturers of welded steel fabrics—to render prompt *service*.

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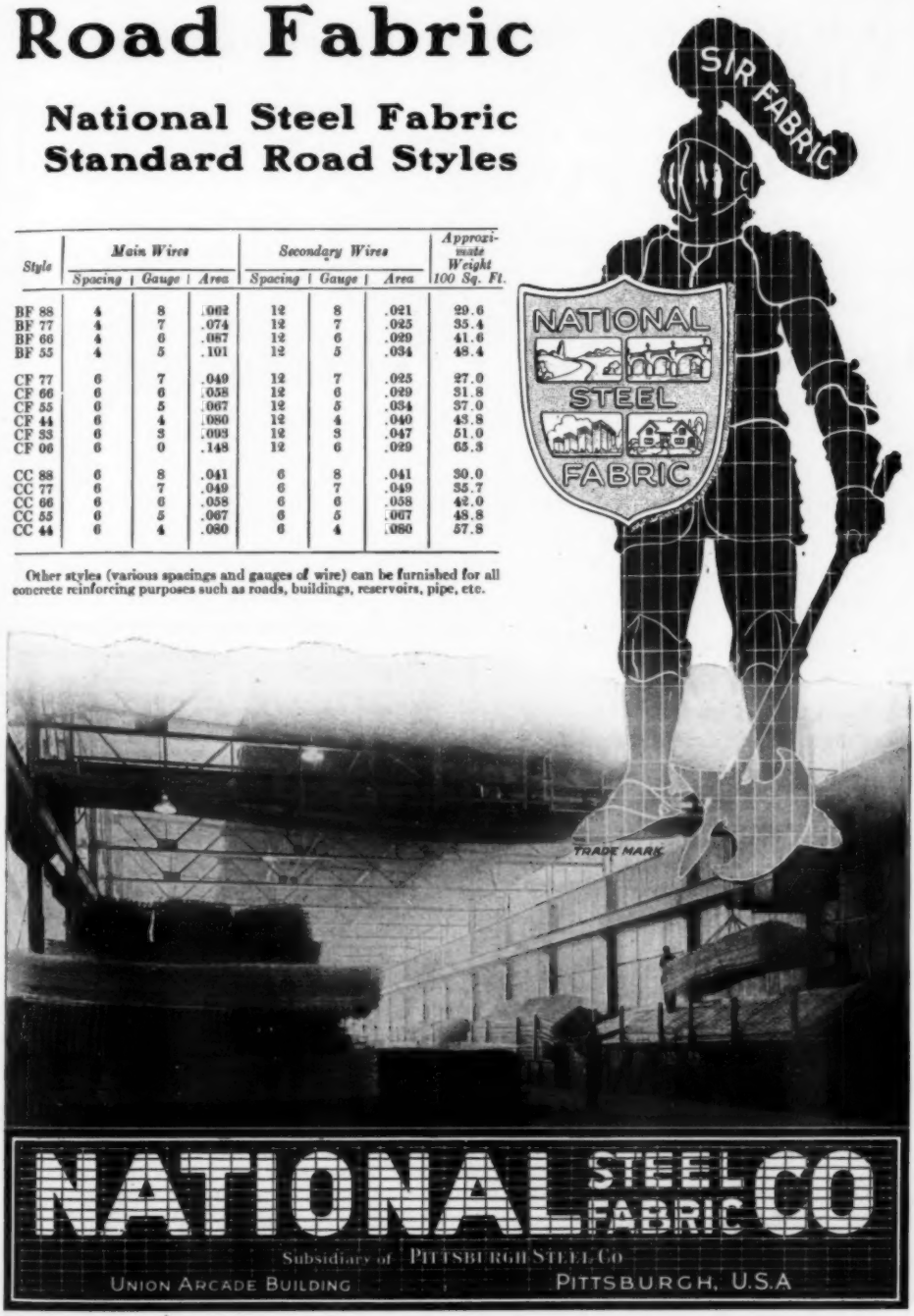
Road Fabric

National Steel Fabric
Standard Road Styles

Style	Main Wires			Secondary Wires			Approximate Weight
	Spacing	Gauge	Area	Spacing	Gauge	Area	100 Sq. Ft.
BF 88	4	8	.062	12	8	.021	29.6
BF 77	4	7	.074	12	7	.025	35.4
BF 66	4	6	.087	12	6	.029	41.6
BF 55	4	5	.101	12	5	.034	48.4
CF 77	6	7	.049	12	7	.025	27.0
CF 66	6	6	.058	12	6	.029	31.8
CF 55	6	5	.067	12	5	.034	37.0
CF 44	6	4	.080	12	4	.040	43.8
CF 33	6	3	.093	12	3	.047	51.0
CF 00	6	0	.148	12	6	.029	65.3
CC 88	6	8	.041	6	8	.041	30.0
CC 77	6	7	.049	6	7	.049	35.7
CC 66	6	6	.058	6	6	.058	42.0
CC 55	6	5	.067	6	5	.067	48.8
CC 44	6	4	.080	6	4	.080	57.8

Other styles (various spacings and gauges of wire) can be furnished for all concrete reinforcing purposes such as roads, buildings, reservoirs, pipe, etc.



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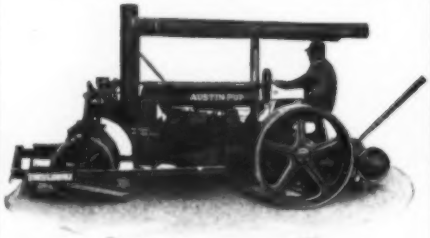
AUSTIN PUP



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Inspired by the demand for a roller that will

Level and roll subgrade
Pull a plow or scraper
Act as a general purpose roller and tractor

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Scarify, level and roll gravel and earth roads
Prepare old roads for resurfacing, and then roll the new material
Act as an all-around roller and maintainer

for County, Township, Village and other public officials.

and best of all

Cost little to buy and to operate; and next to nothing to maintain.

A SPECIAL ANNOUNCEMENT GIVES FULL DETAILS

Act quick if you want one of the first litter.

THE AUSTIN-WESTERN ROAD MACHINERY CO.

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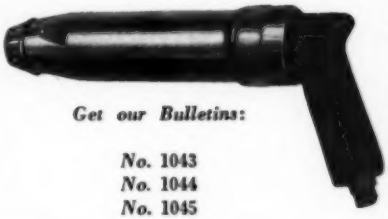
Branches Everywhere

CONTRACTORS

Pneumatically operated tools for surfacing and drilling all concrete surfaces.

Also a complete line of hand tools that are used daily in your work.



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Here is just the type of power drag scraper outfit—inexpensive, easily moved from place to place—that owners of small gravel pits, county highway commissioners and contractors have been looking for. Write for folder.
Sauerman Bros., 464 S. Clinton St. Chicago
SAUERMAN PORTABLE POWER SCRAPER
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Many years of experience with millions of gallons of Texaco Road Oils on every type of secondary road in the country have produced the six Texaco Surface Treating materials which are available for you today.

To provide your earth, macadam, gravel, sand-clay or shell roads with smooth, dustless and waterproof surfaces, ask us to specify the Texaco Surface Treatment which will most efficiently and economically serve you.

A sure way of preserving your roads in ideal condition at the lowest cost is to have the Texaco representative in your territory go over the roads with you. He will recommend the proper Texaco product and outline to you the best method of doing the work.

Ask to have our representative call, and let us send you the booklet on Texaco Road Oils in which you will find much of interest and value concerning the treatment of secondary roads.

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Russell Equipment includes 7 sizes in Road Machines—ranging from the giant Russell Mogul, weight 9000 lbs., to Russell Gem, weight 650 lbs. Also Scarifiers, Drags, Drag Lines, Gravel Screening and Loading Outfits, Culverts, Steel Beam Bridges, etc.

A very complete catalog of special interest to all road builders—sent free and postpaid.

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Every monolithic pavement should have an Expansion Joint. They are placed to take care of expansion and contraction. "PIONEER" Expansion Joint is produced from an absolutely pure asphalt, giving maximum efficiency. Specified, recommended and used by engineers and contractors who take pride in their work and still believe in quality.

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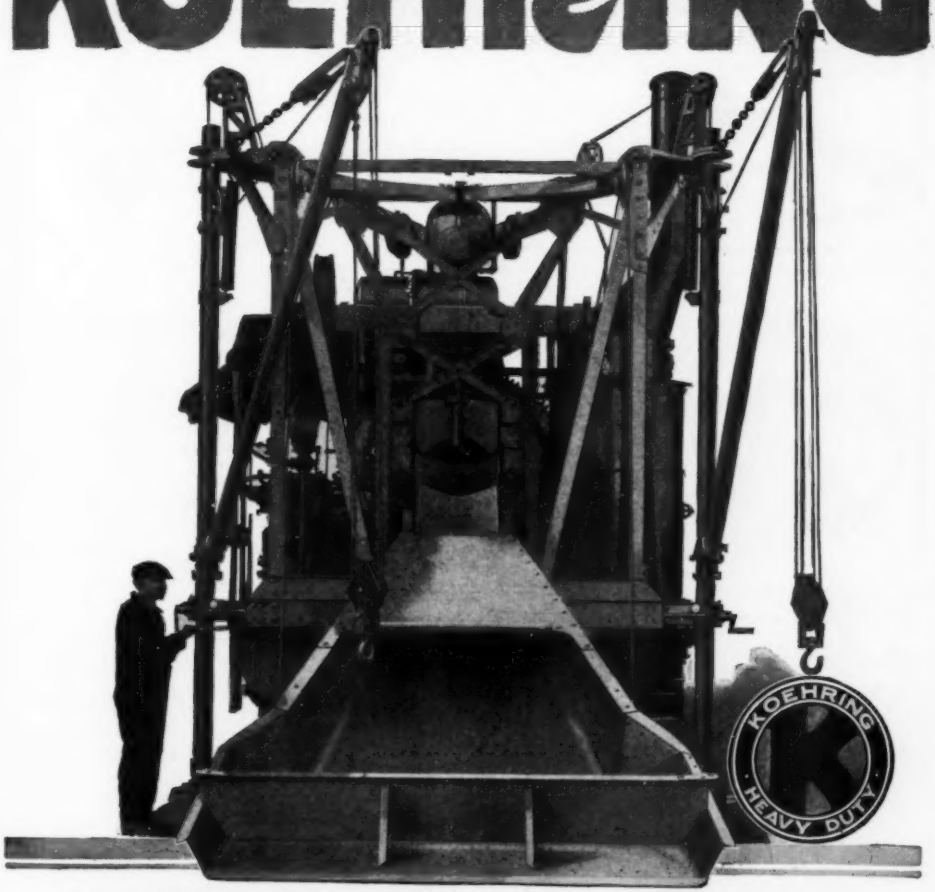
The highest quality of asphalt filler produced. Makes ideal brick pavements. Low prices and immediate delivery on any quantity. Made to meet the strictest filler specifications.

THE PIONEER ASPHALT CO., Lawrenceville, Ill.

KOEHRING



Loading End Strains

THINK of strains that the loaded fast-moving skip puts on the mixer frame! How they must tug and twist at the frame! Hundreds of times every working day. Thousands of times every season!

Now look at the Koehring frame construction—how the frame is braced, and re-inforced against strains and stresses from every direction. This is one reason why Koehring driving parts do not get out of alignment and set up unusual wear, breakages and delays. Get this Koehring "Heavy Duty" construction fixed in your mind, and recall it when you think about mixers.

Koehring Capacities

Pavers: 7, 10, 14, 21, 32 cu. ft. capacities mixed concrete, steam and gasoline. Write for catalog P.

Construction Mixers: 10, 14, 21, 28 cu. ft. mixed concrete, steam and gasoline. Write for catalog C.

Dandie: A light staunch mixer for footings, culverts, foundations, etc. 4 and 7 cu. ft. mixed concrete, steam and gasoline. Power charging skip, low charging platform, batch hopper, light duty hoist. Write for catalog D. Rubber tires optional.

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Protect and reinforce concrete curbs. Positive anchorage is assured; there is no separating or splitting of the concrete at the corners. Owing to their rigidity and convenient size, Truscon Curb Bars are easy to handle and install. Furnished straight or curved.

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The KEYSTONE is a highly versatile traction steam shovel with all the efficiency of specialized design, usable with three different interchangeable scoops — *Skimmer, Ditcher and Clamshell* — for Road Grading, Trenching, Back Filling, Cellar Digging, Pit Mining, Loading, Unloading and Handling Materials. Can be equipped with electric motor drive for use in buildings. Saves first cost, moving cost and upkeep, and is readily sold or rented for any sort of excavation job. A reliable road shovel of remarkable adaptability to other uses.

Model 4, 14-ton All Steel Excavator with ½ yard Skimmer.

Keystone Driller Company

Beaver Falls, Pa.

PROTECT YOUR PAVEMENTS USE

IDEAL EXPANSION JOINT

The Ideal Method of Providing for Expansion in Improved Pavements

CONVENIENT ***SAFE*** ***ECONOMICAL***

A Standardized Preformed Paving Joint made of high grade "filler" asphalt

Shipments made in crates or boxes weighing about 325 lbs.

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From cars to trucks the RELIANCE PORTABLE CAR UNLOADER will save more than its cost in one season.

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Save Those Wages

With a scarcity of men and high wages, no road builder should try to get along without the

Burch Spreader

It spreads road material from the back of the truck to the required depth and width in a fraction of the time and at less than half the cost of hand labor—and does a better job. With it and the Burch Car Unloader you make a saving that spells profit. The commendation of other contractors is our best evidence. Write for it.

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The items listed below make tremendous saving possible to those anticipating additional equipment or replacements.

MASTS— Oregon Pine, 80 to 90 feet long and 24 ins. in diameter, $160.

BOOMS

40 to 50 feet long and 9½ ins. in diameter, $30.

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HOISTS— LIDGERWOOD, AMERICAN HOIST AND DERRICK, FAIRBANKS, double cylinder, single drum, reverse throttle, with foot brake—right and left hand. Good mechanical condition, $75 to $175.

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4½ x 2¾ x 4 ..... $50.00
6 x 5¾ x 6 ..... $80.00
10 x 6 x 10 ..... $140.00
10" centrifugal, direct connected to 6 x 6 steam engine $280

CHAIN— Varying in length nad many different sizes, 3 to 5 cents per pound.

Brass Valves, all sizes, 25 cents per pound.

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Incorporated
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MOST REASONABLY PRICED MIXER IN AMERICA

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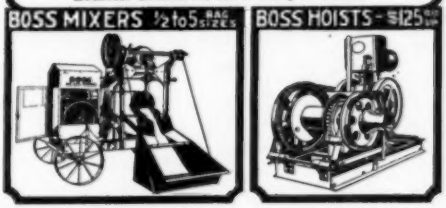

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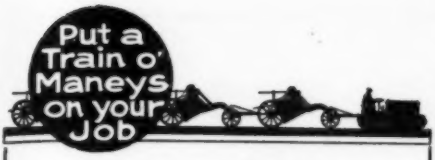

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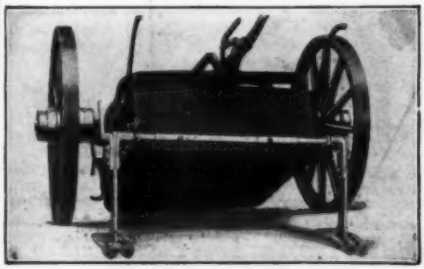

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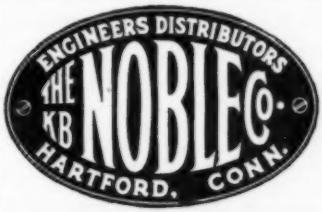

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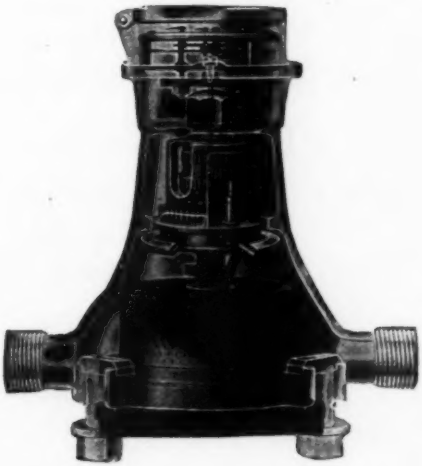

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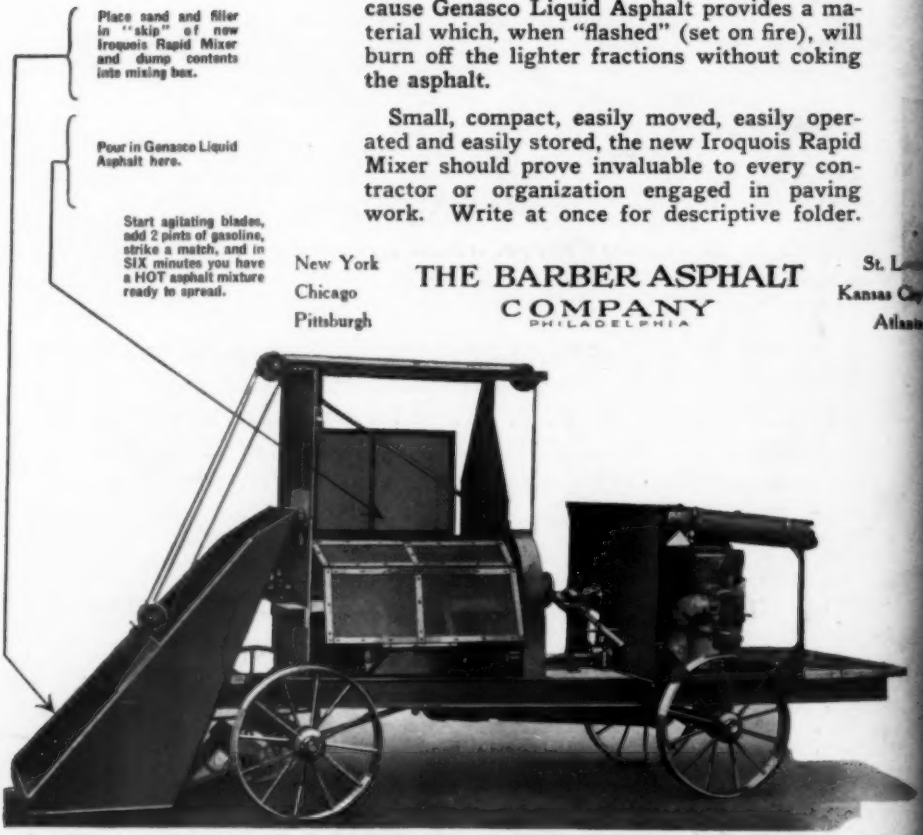
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